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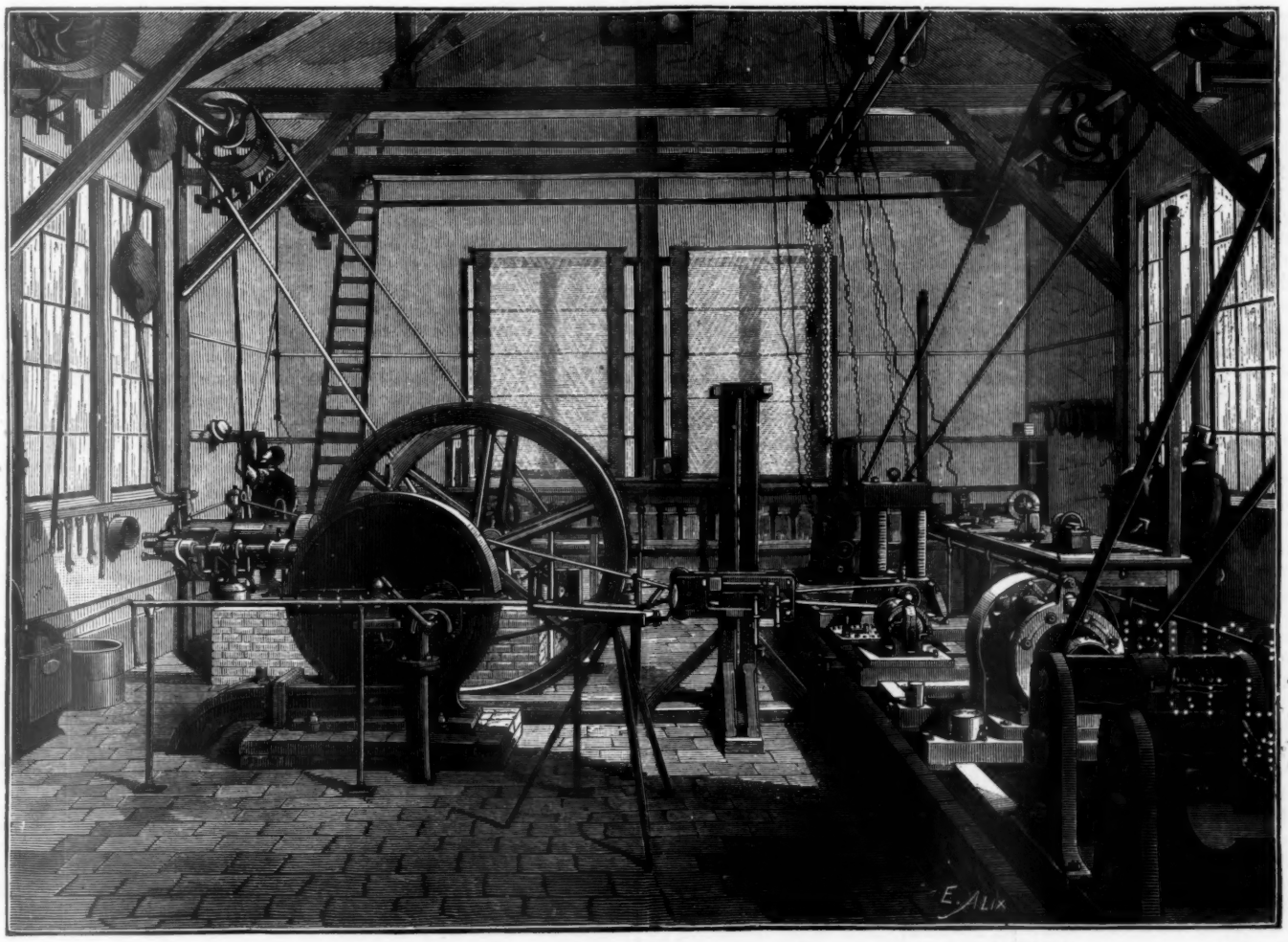
The Montefiore Electro-Technical Institute—Annex of the University of Liege, Belgium.

So long as the domain of electricity remained limited to the laboratory, purely scientific electrical teaching could exist only as a chapter of that of general physics. But now that the already important industrial applications of electricity tend to further development, the necessity for technical study is imposed on us. The want becomes much more urgent as the different branches of electrical industry multiply, may draw the knowledge which ought to be familiar to the electrical engineer.

In Germany there have been created in some polytechnic schools, such as those of Darmstadt, Stuttgard and Aix-la-Chapelle. electrical sections, but the modest resources placed at their disposal have not permitted material installations of the importance to be desired.

In England technological instruction is, as is well known, little in favor; it is astonishing that, notwithstanding the development of the applications of electricity in that country, we do not meet with any superior school there. In France, the sole establishment where an effort has been made to attain this end, is the School of Telegraphy at Paris, founded to secure the recruiting of the *personnel* of the Administration of Telegraphs. But the studies there converge, from necessity towards this special, and rather narrow end. This is a result to be avoided if we would perform a really useful and productive work. A too rigorous specialization is only suitable for professional schools, such as that of the City and Guilds of London, for instance; but applied to a college of engineering it can only result in the formation of incomplete courses of studies. The electrical engineer, by the very fact of his industrial occupation, should possess, in the same degree as all other engineers, a thorough training in several special branches of knowledge.

This principle was the basis of the institution of the Central School of Arts and Manufactures destined to furnish engineers for all branches of industry, and its increasing success during more than fifty years of existence is its best justification. The teaching there is divided into two parts, of which one comprising the general study of the sciences applied to industry is common for all the students; whilst the second, on the contrary, more particularly composed of practical work, is distinct for each of the four specialties of mechanics, construction, chemistry, and metallurgy, whichever the student may choose to adopt. The extensions and constant progress of the industrial applications of electricity have already caused the directors of the school to devote some lessons to them, simple preliminaries to the special courses now become indispensable, and we express the hope, which we believe will soon be realized, that we shall see adopted as a fifth specialty, that of electrical-engineering. This would be a happy modification of the regrettable situation which we have described above. No doubt, too, that this will only be the first step, and that we ought to and must do more. For a good electrical engineer ought to possess varied knowledge and to unite very different aptitudes. His apprenticeship will be long, and the programme of his studies, to be complete, will necessarily present a development beyond the restricted frame-work of a simple sub-division of a general training; especially if we take into account that the lessons on physics given in the lyceums and in the special schools constitute the sole and very incomplete preparation available up to the present time.



THE MONTEFIORE ELECTRO-TECHNICAL INSTITUTE—ANNEX OF THE UNIVERSITY OF LIEGE, BELGIUM.

and telegraphy, telephony, electrical lighting, electro-metallurgy, the transport of force, etc., are so many different fields which must be explored by men specially trained for the purpose. The new industry can only be viable and become prosperous by finding at its service a body of electrical engineers, trained by special studies to take the direction which is confided to them. For, it is only too certain that the defective instruction of those persons who directed them, was often the real cause of the failure of a great number of electrical enterprises undertaken during recent years.

The sole remedy for this state of things, lies in the creation of an electro-technical system of instruction, whence young men

We are then logically brought, as the only satisfactory solution, to the creation of an electro-technical establishment destined to give an electrical instruction as extensive as possible to those who, already engineers, wish to become electricians. Such is the idea, most just in our opinion, which has dominated the foundation of the Electro-Technical Institute of Liege, already mentioned to our readers. Now that the establishment is completely terminated and that a year of trial has demonstrated its vitality, we are happy to return to the subject for the purpose of giving the following details, which have been very obligingly furnished to us.

The initiative of this creation is due to

Senator Mortefiore Levi, an enlightened philanthropist, whom Belgium is honored by possessing. In endowing the University of Liege, where he himself studied, with an electro-technical institute, M. Montefiore has had for his object the opening of a future career to the students, and at the same time the encouragement of electrical industries by facilitating the recruiting of their technical *personnel*. He has generously placed at the disposal of the Belgian Government a sum of 100,000 francs, destined for the acquisition of the materials for the first establishment, and has promised to supplement this gift by others, in proportion as the development of the growing institution shall demand them.

On its part the Government has furnished the space destined to receive the new installations. The approaching reconstruction of the University of Liege has prevented the erection of a permanent building, the place of which has been supplied by provisional constructions and appropriations, which have been made with all the necessary completeness.

The organization of the new course of instruction has been entrusted to Mr. Engineer Eric Gerard, than whom no one could better have acquitted himself of this difficult task.

The principal object of this organization has been to place within the reach of engineers leaving schools of mines, of arts and manufactures, and of civil engineering, the means of acquiring in one year all the knowledge requisite for exercising efficaciously the functions of an electrical engineer. In this manner is answered the wish of a large number of young men, who after having finished their studies, desire to complete them by a course in electricity, without being obliged to review matters already acquired, or being retarded in their progress in electricity. The theoretical and practical courses in electricity have been grouped so as to form the programme of one complementary year of studies, at the end of which the engineers designated above acquire the diploma of electrical engineer. A student may, besides, be admitted to follow the course under the title of an independent pupil, without being obliged to undergo the examinations.

Parallel to this section, formed of young men already having diplomas, there has been instituted a second section composed of students who have made no previous technical studies. This section allows of two years of study also preparatory for the examination as electrical engineer. To be admitted, a solid knowledge of mathematics and physics is required; these can be acquired at the preparatory school of mines at Liege, whose programme is very nearly the same as that of the Polytechnic School of Paris.

The complementary year of study comprises four principal courses, of which one complete course is on the theory of electricity and magnetism, treated both from an experimental and mathematical point of view.

The three other courses have for objects the diverse applications of electricity; the first embraces the construction of aerial, subterranean and submarine lines, as well as the description of generators of electricity; the second treats of the transmission of signals, and includes telegraphy, telephony and electric railway signals; and lastly, the third is connected with the industrial applications of electricity, electric lighting, the development and the transport of force, and electro-metallurgy. Besides these thorough courses, the programme also includes an elementary electro-technical course, designed to inculcate in scholars of the various sections of the special schools of Liege, as well as the public generally, general information of the applications of electricity. The two years of study in the section of electrical students, comprises the four branches above described, as well as applied mechanics, the construction of machines, industrial physics, metallurgy, construction of railways, industrial architecture, and the study of the French and German languages. In the two sections of the institute a preponderating place has been assigned to practical works; the students pass five to six hours every day in the laboratory. That is, in fact, the best means of making progress in the applied physical sciences. These cannot be learned from books any more than can the art of swimming or riding on horseback. The study of books gives the memory too important a place, whilst experimentation develops the sagacity of the pupil and cultivates the spirit of observation that electricians ought to acquire.

To become a skillful experimenter, two physical qualities are necessary. It is necessary to possess a certain manual dexterity and to be familiar with the construction of apparatus, so as to be able to adjust, and in case of need, repair the instruments which are used.

To put the pupils in the way of acquiring these qualities, the Institute of Liege has a workshop in which the scholars learn to use the file and graver and to construct for themselves the measuring apparatus which they use in their first experiments. They learn in this manner to perform experiments with the most rudimentary apparatus. The students are inclined to think that to execute the smallest measurement, delicate apparatus, carefully polished and finished, is necessary. It is good for them to become thoroughly impressed with the truth of the saying of Gay Lussac, often repeated by him, "It is not the bad instrument; there are only bad experimenters."

The utility of this manual preparation has been demonstrated by the fact that during the course of their labors of this year, the scholars have not seriously damaged any apparatus; persons who have made experiments with dynamo-electric machines know how necessary it is to take precaution to avoid deterioration to the measuring instruments.

After having spent two or three months in the practical study of the construction of apparatus, under the direction of a skillful machinist, the pupils begin the work of the laboratory by the standard measurements relative to magnetism and electricity; to learn the determination of the magnetic constants of resistances, of electro-motive forces, of capacities, of intensities, etc.

They pass next to industrial experiments, among which we note the tracing of the characteristic curves of machines and the determination of their products; the study of batteries of great quantity, and accumulators; the photometric measurement of arc and incandescent lamps; dynamometric experiments relative to electro motors; the searching for faults in aerial lines and cables; the adjustments of telegraphic and telephonic apparatus, etc. After having terminated the complete series of measurements, the students take in hand the subject of original research, on which they exercise their sagacity.

The applications of electricity are vast fields of investigation in which one must not fear to enter resolutely when one is guided by correct theories.

It is important to acquire on the benches of the school, not only theoretical knowledge, but also the spirit of imitation and of invention, which should characterize the electrician. We shall see by the development given to the laboratories, the importance which is attached to practical working.

The plan of the space occupied by the institute is as follows: A large hall of 350 square meters, has been divided by partitions into five rooms opening on a lobby, which can be arranged for phonetic experiments. On the right of the main entrance is an auditorium for 50 pupils, contiguous to the hall of models. At the left are two laboratories: at the back a work cabinet with book-cases forms the bottom of the lobby.

Behind these premises a provisional pavilion (shown in our illustration) of 120 square meters for the machines and workshop has been put up. As we remarked before, these installations are destined to be replaced very soon by permanent and more extensive structures. The disposition of the machines has been made with a view to admit of the management of the machines being easily and rapidly made by the students. The hall contains two motors; one Otto gas-engine of eight horse-power, furnished with two fly-wheels to ensure regularity in the movements of the machine, and a turbine of 6 horse-power (with a horizontal axis) of the Bulait system, actuated by water, whose pressure attains 5½ atmospheres. These two motors can be arranged to run independently, and can also be coupled in a manner so as to furnish fourteen horse-power, sufficient for all of the experiments of the laboratory.

These engines furnish the power to the dynamos, six in number; one Edison machine, one alternating Siemens machine, one Gramme electro-motor, and three Gramme machines. These are especially constructed for purposes of demonstration; they work by means of a single ring and their inductors have three different styles of winding. By placing the ring successively in each one of the frames one can easily and correctly compare the particular characteristics of each one of the different styles.

All these machines rest on supports with double slides, allowing them to be moved towards or farther from the pulleys, so as to tighten the pulley belts when required. A block and fall, movable on rails, enables this operation to be performed in a very convenient manner.

The turbine is very well adapted to laboratory experiments; the displacement of a single valve suffices to put it in movement, and to regulate its speed; besides, this form of motor possesses a very great regularity of movement.

Thanks to these motors, two classes of pupils can conduct simultaneously different experiments. In the illustration the turbine is shown driving the Edison machine by the intermediary of the Von Heffler-Alteneck dynamometer; while the gas engine is represented as furnishing power to a Gramme machine, and the Siemens machine. An idea of the convenience of this installation can be gathered from the fact that in less than an hour all the elements necessary for the determination of the characteristic curves and of the product of the machine can be recorded.

At the rear of this room may be seen a battery of 35 Faure-Sellar-Volckmar accumulators of 30 kilogrammes, used for lighting the various parts of the Institute by incandescence. This battery also furnishes the current necessary for the experiments of the course. In a case like this, where electricity is required at any moment and under very variable tensions, the use of accumulators is indicated.

The machinery pavilion contains a workshop where each student has his vice, tool-cabinet, lathe, pedal-saw, forge, carpenter's kit of tools, etc. Around the pavilion runs an aerial line having a wire of 5 kilometers length, which is connected with commutators in such a manner as to serve for a rheostat in case of need.

The laboratories are provided with very complete sets of apparatus for electrical measurements, among which is a Kew unifilar magnetometer, a galvanometer for absolute measurements, Thomson & Wiedemann's reflecting galvanometers, Thomson, Mascart, Edelmann & Lippmann electrometers, balances, photometers of Bunsen, Ayrton, Foucault, etc. The work-tables are solidly fixed on pillars of masonry built on the ground so as to be free from exterior vibrations. Along the walls are placed brackets on which are installed the reflecting apparatus requiring a partial obscurity. All of the connecting wires are suspended overhead and arrive at the tables on supports with which they are provided; thus allowing the more easy tracing of the wires in case of necessity, than would be the case if they were placed under the floor. We will not go into any further enumeration of these details, nor describe the hall of models, which contains a collection, already very complete, of apparatus employed in the different applications of electricity. What we have said so far will suffice to show the care which has been taken to initiate the students in experimental work. Everything has been disposed in a manner to realize the end kept in view by the organizers of the Institute; to turn out engineers to whom no portion of the theory of electricity shall be unknown, and who possess at the same time enough practical knowledge to render real service from the moment of their entrance into an electrical industry.

The experience of one year has shown that the foundation of a school of electricity responds to a real want. The installations were not quite completed when eighteen students, of whom eight were foreigners, had inscribed their names for the course. It will be, then, preceded by a former success, that the Institute of Liege will enter during the month of October next into the second year of its existence, which, no one can doubt, will be long and prosperous.

The success of this happy initiative which we have here recorded, is an encouragement and a fruitful example, which, followed promptly in other countries, will be the surest guarantee of the progress of electrical industry.—*La Lumière Electrique.*

Some Relations of Positive and Negative Electricity.

If a point connected with a Topler-Holtz, or any other powerful electrical machine, is brought to within about an eighth of an inch of a candle flame, the flame is blown out when the point is positive, but has only a slight depression in it when the point is negative. Many variations of the experiment with both candle and Bunsen-burner flames were tried, but the most marked results were obtained by putting positive and negative points of opposite sides of the flame, the result being a depression opposite to the negative point and a hooked point of flame reaching out above, or at one side of this, and touching the negative electrode a short distance above its point. If the hook had appeared only above the negative point it might have been explained by a composition of two forces, viz., the upward draught of the flame and a current moving from the positive to the negative point; but when the points were not directly opposite, the hook appeared at one side.

With the candle flame grounded, the phenomena were nearly as marked, and with the candle insulated, there was still a slight depression opposite the negative point.

To test the question further, a piece of paper, about two inches square, was glued to the end of a piece of ebonite, and introduced between the knobbed-tipped poles of a Topler-Holtz electrical machine whose Leyden jars had been removed. When the paper was brought near either pole, it was repelled until very near, when it was attracted and clung to the pole. If this were negative, the brush discharge pierced the paper, but if positive the discharge passed to the paper and from its edges to the negative knob.

Paper coated with stearine acted like a plate of ebonite.

When a strip of paper 3 inches by 1½ inches was used, and was brought near either pole, its top bent over toward the other pole. When one of the knobs was removed the repulsion from the blunt point, whether positive or negative, was much more marked than before. With both knobs removed, there was a slight repulsion near the positive pole, but none perceptible near the negative, and the paper adhered to neither point.

It having thus been proved that there was a discharge from both positive and negative poles, whether these were points or knobs, and that the positive discharge was the stronger, experiments on the nature of these discharges were next made.

Pointed carbon crayons and slips of paper soaked in a solution of chloride of copper or strontium were placed opposite a Bunsen-burner flame.

The flame gave flashes of color when the point was either positive or negative, but more frequently when the point was negative. With the burner between the knobs of the machine, and one knob covered with paper saturated with cupric chloride, the

coloring of the flame when the paper was negative was the most marked.

One knob was next covered with paper coated with lampblack, and to the other was glued a clean flat piece of paper. When the blackened knob was negative, more lampblack was carried over than when it was positive, but a very loose coating on the blackened knob sometimes gave reverse results. Lead and charcoal points gave no results.

These results seem to indicate that the negative discharge is largely composed of particles of the pole.

The currents of air set in motion by the negative particles make the phenomena, two or three inches from the point, nearly similar for both positive and negative.

In the course of these experiments some other interesting phenomena were noticed.

1. When the paper sectors of a Topler-Holtz electrical machine were connected by a bad conductor, such as the hand, or an insulated wet string, the machine always reversed, but would not always do so when a wire was used. The phenomena corresponds to the oscillatory discharge of Leyden jars investigated by Fedderson, Oettingen, and others, and seems to indicate a momentum in the discharge. The use of a poor conductor in making the connection prevents a return discharge.

The experiment will not succeed immediately on starting the machine, for the potential of the sectors is not then sufficiently high.

2. Sparks can be obtained between parts of the machine which have the same sign.

3. Various effects were found with a magnet, but tests showed these to be due to the magnet being a conductor. One of the knobs of a Topler-Holtz machine was removed, thus leaving a blunt point opposite a knob.

When the point was positive and grounded, the knob was pushed towards it till sparks passed between them. If the grounding wire were removed, then the sparks passed into a brush discharge. Replacing the wire caused the sparks to again appear, and so on *ad infinitum*.

Placing the wire on the negative knob has the same effect as removing it from the positive point.

4. From one to four points were placed opposite a knob. The result differed from those obtained with a single point only in that the brushes on the inner positive points were always smaller than on the outer ones, and usually bent out so as to join these before the knob was reached.

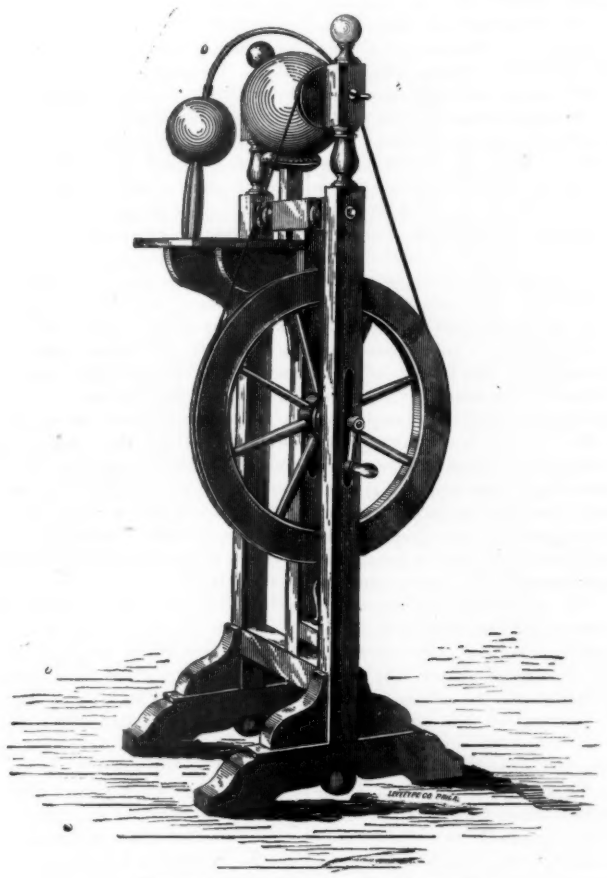
With one and two points on each pole the brushes were so short that no definite forms could be made out.

When a glass tube was placed over a positive point a glow was visible on the point, and brushes appeared on the edges of the tube.

When the Leyden jars were moved, and the poles consisted of two blunt parallel rods about a quarter of an inch apart, the discharge was chiefly at the negative pole, but passed to the positive when the negative rod was grounded.—*H. W. Eaton.*

The E.M.F. of Amalgamated Zinc.

In a note on this subject by M. G. Lippmann, in the *Journal de Physique*, he observes that generally a greater E.M.F. is attributed to amalgamated than to pure zinc. If a plate of each of the two substances be immersed in a sulphate of zinc solution, a couple is formed in which the amalgamated zinc forms the negative pole, inasmuch as it is the more readily acted upon by oxygen. Such, at least, is the result obtained if special precautions be not adopted. In a recent work, M. W. Robb shows that, if care be taken to use pure zinc obtained by electro-deposit, and also sulphate solutions which have been deprived of all free acid by remaining on carbonate of baryta, the element will not manifest any appreciable E.M.F. The negative result obtained by M. Robb may be confirmed by the following line of reasoning, founded on Carnot's principles. If the zinc and amalgamated zinc couple had a fixed E.M.F., it might be possible, by closing the circuit, to cause the current to produce some definite mechanical work. On the other hand, since the amalgamated zinc behaves as the metal attacked, the effect of the current is to get rid of the amalgam, separate the mercury, and transfer the zinc which it contained to the surface of the pure zinc. In this way, at a very small cost, the couple might be regenerated by collecting the zinc thus deposited and conveying it mechanically to the mercury side, where it would again become amalgamated; in fact, definite quantities of work might be produced while only expending the insignificant labor of transferring the zinc by hand. Now this would be incompatible with Carnot's principle. Not that it would be incompatible with the principle of equivalents, for the amalgamation of zinc produces cold, so that the heat absorbed by this amalgamation might be the exact equivalent of the work done. This is even, as explained by M. J. Regnault, the working of the element by the disamalgamation. But according to Carnot's principle, the transformation of heat into work can only take place if there be a simultaneous passage of the heat of a hot body into a cold body. In other words, it is not possible to construct an apparatus which produces work on the simple condition of producing an equivalent quantity of cold. Now the zinc and amalgamated zinc battery would be precisely a case in point. On the other hand, the cadmium sulphate pole of the cadmium and amalgamated cadmium element manifests an appreciable E.M.F. The pure cadmium is dissolved and transferred by the effect of the current to the amalgamated cadmium. In this case, the above line of reasoning cannot be adopted, and Carnot's principle is no longer applicable. This pole cannot, in fact, be regenerated except by depriving the cadmium of its amalgam. Now this operation cannot be performed mechanically; and to be effected electrically it would require an expenditure of power at least equal to the production of of the work due to the current.



THE FRANKLIN ELECTRICAL MACHINE.

Lighthouse Experiments.

When Dr. Tyndall resigned his position as scientific adviser to the Board of Trade and the Trinity House, he did so, says the *Journal of Gaslight*, chiefly on the ground that he could not be a party to what he considered a one-sided investigation as to the respective values of gas, oil, and electricity as lighthouse illuminants. Inasmuch as Sir James N. Douglass, the engineer to the Trinity House, had a pecuniary interest in oil lamps, which he had patented, Professor Tyndall thought he ought not to have any voice—through his Board or otherwise—as an adjudicator in regard to the respective merits of the three illuminants. That Dr. Tyndall was right in urging this point soon became apparent, for the Illuminants Committee would not allow the Commissioners of Irish Lights to exhibit, in the experiments, the most powerful form of gaslight which Mr. Wigham had devised; and believing that the experiments would be quite futile unless this were done, the Irish Commissioners withdrew, and the committee was dissolved. Strange as it may appear, the Board of Trade subsequently entrusted the whole inquiry to the Trinity House; and the experiments frequently referred to of late in our columns, have been organized and conducted by them with the assistance of their engineer. So far, they have carried out the programme precisely as the Illuminants Committee intended it to have been carried out. They have erected at the South Foreland three lighthouse lanterns—A, containing the electric light; B, the gas light; and C, the oil light. The towers were placed sufficiently far apart to enable the lights to show to the horizon without blending. The Trinity House, being of the same mind as they were when in the majority of the Illuminants Committee, still, we understand, refused to allow Mr. Wigham's double quadriform gaslight to be shown; alleging, as their reason, that it had not yet been used as the illuminant in any lighthouse. They therefore, in the B tower, fixed an ordinary quadriform gaslight, such as is used at Galley Head. In the A tower they fixed an electric light of enormous power, produced by the action (combined or separate) of three of De Meritens' largest dynamos. No such electric light has ever been exhibited before at a lighthouse; and in showing this one at the South Foreland, the Trinity House seems to have forgotten the rule under which they excluded Mr. Wigham's best gaslight. In like manner, in C tower, they placed three of Douglass' patent oil burners over each other, although no such arrangement had ever been adopted at any lighthouse. The nearest approach is at the new Eddystone Lighthouse, where two such oil burners have been used. Thus, at the very outset of these experiments, gas seems to have been placed unfairly at a disadvantage. Nevertheless, the observations of the lights which have been made (now extending over many months) have shown that, in the ordinary state of the atmosphere, the electric light is the brighest (next comes gas, and last oil); but in hazy weather, and more especially in fog, the order has been: Gas, first; oil, second; electric light, last. If this be so, how much more markedly may we suppose gas will come to the front for lighthouse purposes when Mr. Wigham shows his double quadriform light. The arrangements of the Trinity House for the observation of the lights have been very elaborately and carefully made. Huts have been erected at various distances from the lights, and lines of observation staked out between them and the lanterns. Intimation of the experiments has also been given to mariners navigating the channel, and they have been requested to observe the lights, and transmit their reports to the Trinity House. The observers in the huts are light keepers in the service of the Trinity House, and the masters of the lightships belonging to the corporation, have also been requested to send in reports of their observations. The American and French Governments have appointed representatives to observe and report upon the experiments. It would, of course, be premature to pass any conclusive judgement respecting the usefulness of these three lights for lighthouse purposes until the various reports have been completed and made public. But enough has transpired to warrant us in the expression of our belief that a great victory has been won by gas; and that if this mode of illumination be given full scope by lighthouse authorities, methods for its application as yet unthought of will speedily be adopted to the great and lasting benefit of seafaring men.

Franklin's Electrical Machine.

Through the courtesy of the Franklin Institute we are enabled to illustrate herewith a notable relic, which will be examined by all students of electricity, with special interest. It is the original electrical machine of the philosopher Benjamin Franklin, and doubtless served its illustrious possessor in many of his experiments and investigations, which aided in laying the foundations of the then infant science. The machine is a frictional machine of the cylinder type, and its parts are so plainly exhibited in the very faithful engraving, that they will not need to be rehearsed. This interesting relic, the authenticity of which is vouched for upon the most respectable evidence, has for many years been the property of the Franklin Institute, and has occupied a position of honor in the Library Room, an object of interest to all visitors.

It was presented to the Institute by Dr. John Redmond Coxe, of Philadelphia.

The Franklin Electrical Machine will be shown at the forthcoming Electrical Exhibition, in the group of Historical Electrical Apparatus, together with numerous other personal relics of the philosopher.

Electric Filter.

Dr. Dobell lately advised that noxious germs should be destroyed by passing an electric current through the water that contains them. A similar idea appears to have occurred to Dr. Stephen Emmens, who has devised an electric filter, consisting of a glass vessel in which are placed porous vases. These latter contain coal or spongy iron, and also carbon plates connected with the positive pole of a Leclanche battery, being kept apart by other carbon plates communicating with the negative pole. The water to be filtered flows into the porous vases, passes through the coal or spongy iron, and runs out of the containing vessel. Like Dr. Dobell, Dr. Emmens supposes that the oxygen set free destroys all the germs which might render water injurious to health. The invention is also applicable to the purification of sewage waters, in which case the filter takes the form of a conduit, divided by partitions into a series of elements, traversed in succession by the water. The electrodes are wooden cages, alternately filled with pieces of iron and coke. With this arrangement a primary battery is not necessary, for the conduit itself forms a powerful battery, the current of which is more than sufficient.—*L'Electricien.*

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Austria is going into electric railways on a liberal scale, an extensive system of communication being planned, the cost of which is to be 7,000,000 florins. The house of Siemens & Halsk, which has done so much for the development of the industrial uses of electricity, is to construct the projected system, which is expected to revolutionize street travel in the chief Austrian cities.

In Buffalo, during the day, power for driving the generator for ringing telephone bells is got from a factory near the exchange, but at night, when the factory is shut down, other means have to be resorted to. For a long time hand generators were used, but this was found inconvenient. The copper line to Niagara Falls had thrown the old iron line out of use, and it occurred to somebody that a magnetic current might just as well be got from the Falls, where the generator is kept in constant operation by water-power. Hence it happens that the telephone bells in Buffalo, when sounded after nightfall, are rung by the power of Niagara Falls—just a little of it.

LONG DISTANCE TELEPHONING.

In the West telephoning over long distances, by which we mean distances varying from fifty to one hundred or even, in some cases, one hundred and fifty miles, does not seem to give rise to any special difficulties, except that, in some cases, during that portion of the day when the temperature of the air, consequently of the wires, and of the earth are widely unequal. In that favored region an ordinary iron wire is used, and connections are made through a central office in the same way as though the two subscribers desiring to talk belonged to the same exchange. But in the more thickly settled East, where overhead wires are numerous and the earth is full of "grounds," and perhaps for other reasons as yet imperfectly understood, long distance telephoning over a single wire has not proved successful, although, under exceptionally favorable conditions, notably at night and on Sundays, some very fair results have been obtained. To overcome this difficulty, and to ascertain by experiment the best way to establish communication over long distances, in such a way as to make it commercially useful and serviceable, the Bell Telephone Company undertook the construction of a double copper line between Boston and New York. Although, owing to peculiar local conditions, the line was maintained intact with much difficulty, and there were many days when communication was interrupted, the experiment, telephonically considered, was a complete success. Talking in Boston was as distinctly heard in New York as though the transmitter had been in an adjoining room in the same building. Thus the fact was established that, with a complete copper circuit, long distance talking could easily be accomplished in the East. But when it came to rendering the line commercially useful the problem of connecting in subscribers, who were connected with the central office at each end, where the terminals of the copper circuit were located, had to be considered. By the use of an induction coil it was found possible to get good results with a "leg" on one end, but when it was sought to connect a subscriber's telephone in one city with a subscriber's telephone in the other, that is, to use the double copper line in connection with a single grounded line at each end, the result was not wholly satisfactory; and it became evident that, in order to make the service commercially useful, the better way would be to take subscribers specially for it, to connect them with the central office in their city by means of two copper wires, and to set up a special telephone on their premises for this long distance service exclusively. We understand that this is the plan which has been adopted by the Southern New England Company, into whose hands the copper circuit has passed, and that it will, in Boston and New York, as well as in Hartford, New Haven, and the other cities through which it passes, solicit subscribers who, on the annual payment of a round sum, be privileged to use it a certain number of times each day. It is believed, for instance, that the manufacturers in Western Connecticut, all of whom have offices and warehouses in New York, will be willing to pay liberally for the privilege of talking directly between their factories and their business offices, and that there are enough of these to warrant the belief that the service will realize a sum sufficient to make the copper line a handsomely paying investment. Beside this, the line will of course be open for public use on payment of a stipulated sum, but, in this case, it will be necessary for the parties who wish to talk to go to the offices in the two cities.

Encouraged by the success so far attained, the Bell Telephone Company is now planning the construction of a system of copper circuits between New York and Philadelphia. We speak of a system, because it is probable that more than one circuit will be established. The distance is but ninety miles, and the two cities are so large, and their relations so intimate that it is believed a very large number of subscribers can be got at both ends. Should this prove satisfactory and remunerative, there is no reason to doubt that the system will be extended still further, certainly to Baltimore and probably to Washington.

THE ELECRTIC LIGHT IN ENGLAND.

There is, perhaps, no greater fallacy than the idea, popular in this country, that the English people are, in business matters, conservative and unspeculative in their propensities. Take up either of the London dailies in flush times, when money is plenty and cheap, and you shall find upon its first page glowing prospectuses of joint-stock companies for every purpose under the sun, full of big figures and seductive promises, and so shrewdly and artfully put as to put the wildest American kite-flyer to shame. They are all organized under the "limited" act, and so numerous are they that the business of "promoting" them has become a recognized industry, and gentlemen who move in very respectable society do not hesitate to describe themselves as "promotors." As a rule, these companies are organized for working mines in some outlandish part of Her Majesty's dominions, or for carrying on a general banking or trading business in an obscure corner in one of the many British Colonies; but whether it be for gathering ivory in the interior of Africa, or the exhumation of fossil mammoths in the interior of ice-bound Siberia, the gudgeons bite with equal freedom; the funds pour in with such lavishness that not unfrequently subscribers have to be content to take a portion of what they asked for; the company fit up elegant offices, the officials vote themselves big salaries, and, in nine cases out of ten, do next to nothing. Of course the end comes in time; there is a grand flare-up; the lawyers get hold of the matter and consume the remaining assets, and very soon some new thing comes up to occupy the public's mind, inflame the public's cupidity, and draw upon the public's purse. But the particular thing upon which the company was founded, whether banking in Timbuctoo or pearl fishing in Ceylon, is forever barred, the fault being laid at the door of the alleged industry, rather than at those of the parties who got up the company.

With this much by way of preface, we may more readily understand the disfavor into which electric lighting has fallen in England. When first introduced there it had all the novelty and mystery about it calculated to captivate the mind of the investing Briton. The light was bright, beautiful and new, and there were possibilities in it that led people to believe that the profits would be enormous. Companies were started with a capitalization by the side of which the wildest figures ever seen in America seem moderate and conservative; enormous prices were paid for patents, and business was begun in a very small way, the office expenses and official salaries forming by far the larger part of the expenditure. Of course things came to an end, the companies collapsed, an event which was inevitable, considering how they were loaded down with fictitious capital, there was a grand row and no end of litigation, and, as a result, the public has not only practically lost its money, but has no lights to show for it. Hence electric lighting is out of favor in England, public favor having swung over as far in opposition to it as it formerly stood in its favor.

There is another point which deserves to be considered, a disadvantage under which the electric light labored more particularly in England than in any other country. Nowhere is gas so plenty and cheap. Coal and labor, the two things necessary in its manufacture, are phenomenally cheap, so cheap that gas is furnished in Manchester for about seventy-five cents a thousand feet. It is true that the low price of fuel and of labor would be a great advantage to electric light companies, and there is no good reason why a company organized on a conservative basis, economically managed, with a solid, unwatered cash capital, could not do as well in England as here; but until the present prejudice wears off it will be useless for any one to attempt to establish it there. At the present time there are, practically, no electric lights in England, and gas holds undisputed sway. In some of the theaters, hotels and eating-houses the incandescent light is used locally, with very satisfactory results as to economy, and its use on shipboard is extending very rapidly, because of its absolute safety, but general street and store lighting, as practiced in this country, is practically unknown and unwanted, simply because it has been put under the ban by the business methods employed by those who first introduced it.

The "Buffalo System."

HOW THE "PAY FOR WHAT YOU GET" IDEA WORKS IN THE TELEPHONE BUSINESS IN BUFFALO.

[Correspondence of the ELECTRICAL REVIEW.]

BUFFALO, N. Y., Oct. 14, 1884.

It is pretty generally known among telephone men that in Buffalo the "toll system" of payment for the use of the telephone prevails exclusively, and it is generally known and understood that its use gives satisfaction both to the public and to the local company, but just how the business is managed is not generally known, and this it is my purpose to describe somewhat carefully in this letter, to the end that readers of the REVIEW may understand the working of the "Buffalo system" in detail.

It should be understood in the beginning that this system is founded upon the idea that each subscriber shall pay for exactly what he gets, that he shall have no more and no less than he pays for, and that, unless his business or private needs are enough to warrant his paying for a certain minimum amount of business, it will not pay the company to put in a telephone for his use. The minimum amount of guaranteed business for which the company will put in a telephone is five hundred messages or connections per annum, and the rate for this is fifty dollars, paid in two semi-annual installments in advance The would-be subscriber pays $25 down, signs a contract to pay a like sum six months later, and then gets his telephone. Every time he calls a record is made of the fact by a very ingenious yet simple method, which I shall describe later, and every call is charged against his credit of 500 connections until that credit is exhausted, provided the number of calls in the year is sufficient to exhaust it. If not, the number standing to his credit at the end of the year is his loss, and he begins again with a clean slate and nothing carried over from the previous year. Should he exhaust his credit before the year is out he can renew it until the year's end by buying a supplementary number of messages in even hundreds at six dollars per hundred. If, however, at the beginning of the year, he had foreseen that he would need more than the minimum number of messages, he could have purchased the required credit at a price still more reduced. For instance, had he guaranteed to the company one thousand connections he could have had them for $75 for the year, that is, $50 for the first 500 and just half as much, or $25 additional for the second 500. The rates go on decreasing as the number of messages guaranteed increases, according to the following table:

500	mess.	$ 50	addi.	mess.,	$6	per	hun.
1000	"	75	"	"	5	"	"
1500	"	95	"	"	4	"	"
2000	"	110	"	"	3	"	"

Contracts for amounts over 2,000 messages are made at the rate of $2 per hundred for the excess. Thus, for 3,000 messages the price would be $110 *plus* $20, or $130, or 4⅓ cents each. These prices are all based on the use of a wire extending not more than one half a mile from the exchange. Additional distance is at the rate of $20 per mile per annum, irrespective of the amount of business transmitted over it.

It will thus be seen that it is made for the interest of large users of the telephone to contract at the outset for a large amount of business, but, whatever their needs may be, the law is irrevocable that they shall contract for it in advance, pay for one-half of it in advance, and sign a

contract to pay for the other half when six months are over.

It will naturally be supposed that all this will require a great deal of intricate book-keeping, and many entries in each subscriber's account, especially as a record must be kept of every connection made and charged, but a very little investigation will show that this is a mistake.

Let us visit the Buffalo Exchange, and see just how it is done. We find it to be a large, high studded, well-lighted well-ventilated and neatly carpeted room, with an air of convenience and refinement about it, which shows that the comfort of the operators has been considered. They sit with their backs to the light, so that the boards, which are of the Gilliland pattern, are well lighted. The boards stand at a distance of about three feet from the wall, giving ample room for getting at them behind for work, which is facilited by the fact that the light shines through. The wires come in in cables from the tower, and are carried in a box along the ceiling directly over the boards, fifty coming down in a "fan" to each. Each operator has five strips for each of the other boards, and the connections are so made that the group of five strips on each board that represent that board is nearest the operator and most conveniently reached. This, of course, is not at all peculiar to the "Buffalo system," but it is necessary to understand it in order to follow the system through.

Each operator has a block of small tickets within reach, at the head of which is the letter, A, B, C, D or E, etc., which denotes her board. Next come five blank lines, numbered from one to five, indicating the first, second, third, fourth or fifth strip, as the case may be, in any group of five. Next comes the word "For . . . . . ." and next "Charge . . . . . ." Now suppose that on the "I" board .445 drops. Against the word "For" on the blank, after having connected in her telephone and while answering, the operator writes "445," because it is "for" subscriber 445 that the connection is made. Let us suppose that the subscriber calls for 744. She immediately glances as the group of five strips which connect with the table to which 744 belongs, and, selecting one not in use, writes 744 upon the ticket upon the line corresponding with the strip selected. For instance, she sees that the second strip is free, and writes 744 upon the second line. Practice makes her perfect and quick in this, and hardly has she heard the number before she has selected the strip and written the number down.

I

1.....
2..... .....744.....
3.....
4.....
5.....
For.... .....445.....
Charge.....

The moment the ticket is filled out the operator places it on a spike by her side, and almost before it is fairly there one of the three or four slippered boys who are quietly on the watch takes it and carries it to the operator to whose board 744 belongs. She sees at a glance what is wanted is a connection between 744 and the second strip in her "I" grup. This she makes, calls, sees that the parties are talking, and her work is done. If, at the moment the ticket comes she chances to be busy, the ticket lies there with its complete record. The operator who sent it has no further responsibility in the matter, and no operator is kept waiting for another to take her work from her. Let me say here that when the parties are through and "ring off," both drops fall, which notifies both operators to disconnect.

Now let us follow the ticket. As soon as the connection is made the operator puts it on a spike at her side, where it takes its place with others that have been received in a similar way. Once an hour one of the boys collects all the tickets and puts them up in a bunch which is marked with the hour of collection and laid away. The hours of the day are numbered from 1 to 24, beginning with twelve midnight. Hence, when the day is over, there are twenty-four packages, each containing a record of an hour's work, and, combined, containing a complete record of a day's work, so complete that it shows for each connection who the parties were that talked, in what hour the talk took place, and at what boards the connections were made. As each operator is required to register every time she comes on and goes off duty, and the board she is at, it is easy to trace the message to the individual operator if need be.

In an adjoining room sits a young man who, when not otherwise engaged, sorts out the tickets, but, before breaking up the packages which represent the several hours of the day, he stamps each ticket in red, with the day and hour represented by the package from which it came. Thus, "11.3" would mean the third hour of the eleventh day. Special stamps, with two sets of consecutive numbers, are provided for this, and the work is done very rapidly. Next, the tickets are sorted out by letter; that is, the "A's" are put together, the "B's" the same, and so on, with the exception that, if any have a number on the "charge" line, they are laid aside for the moment, for a reason which will presently appear. Around the room are a number of cases which look like diminutive clothes presses. Inside of each is a frame, and in the frame are four upright square posts, of perhaps two inches face, in each face of which are fifteen sharp spikes. The sixty spikes on the four corresponding sides of the four posts represent the fifty subscribers on any one board, with ten to spare, and the three other sets of four corresponding sides in the same way represent three other boards, with a similar allowance to each for extras, and the result is that each case has spikes sufficient for four boards, or two hundred subscribers. Now, the boy would find our "I" ticket in the "I" package. The first case represents boards A, B, C, D; the second, E, F, G, H; the third, I, J, K, L It would, therefore, be in the first set in the third case that he would find the spikes representing the subscribers in the "I" board. The first post would be numbered from 401, say, to 412 (some subscribers have so many calls that two spikes have to be assigned to them); the corresponding face of the second post from 413 to, say, 426; the corresponding face of the third post from 427 to, say, 440; and the corresponding face of the fourth post from 440 to 450. Hence, it would be on the first face of the fourth post that our ticket would belong, and there it would go, because, it will be remembered, it was "for" 445 that the connection was made, and to him it must be charged. All other calls made by 445 in the course of the month would be charged in the same way; and, at the month's end, it is a very easy method to count up his tickets, and place their number to his debit against his credit previously described. Thus one book entry every month keeps the account in shape.

There remain to be accounted for the blanks having a number on the "charge" line. For instance, if 445, instead of being at his own telephone, had been at some other, and wished to call his own station, he would call "445 collect," and the message, instead of being charged to the calling station, would go against the 445 account. Hence, any ticket with 445 on the "charge" line would be put on the 445 spike, irrespective of the letter at its head.

At the outset the telephone business in Buffalo was not managed in this way, but on the ordinary arbitrary price system. The disadvantages of the latter very soon became apparent, and a radical change was determined upon. The reasons which led to this change and an outline of the new plan were set forth in a circular to subscribers, in which the whole matter is so fully explained, and the reasons so clearly given, that I cannot do better than reproduce it entire. It is as follows:

BUFFALO, N. Y., Jan. 1st, 1881.

DEAR SIR: The system of arbitrary rates used by the Bell Telephone Company of Buffalo, in common with other telephone exchanges, has proved to be very unsatisfactory to the majority of our customers, and, believing that we have found a system in every way more just and equitable, we ask you, as a business man, to consider fairly the following statement of facts in regard to the growth and development of the telephone business. If the plan proposed by us seems in your judgment to meet the requirements of the situation, we trust that you will give us your co-operation in extending the use of the telephone among your business connections, so that the increase in facilities which we hope to afford our subscribers, and the more general use of our lines by the public, may be a source of mutual advantage.

Under the present conditions of the exchange business, it is the interest of the telephone companies to restrict the use of their lines to a small number of customers, at necessarily high rates, and to limit the use as much as possible.

These conditions are directly opposed to the interest of subscribers, limiting the usefulness of the exchange to them, and burdening them with a price, which in many cases is out of proportion to the amount of use, but which must be charged to make up for the enormous use of a few subscribers, and the "dead heads" who are not subscribers, but enjoy their privileges at the expense of those who pay.

In its inception the "Exchange System" was used simply for the purpose of connecting with each other private lines already established, and was intended to be used solely for the private business of a few individuals. As soon, however, as the usefulness of this arrangement became known, a demand sprung up from the general public to be provided with instruments and exchange service.

At this time so little was known of the business and so light were the demands for service, that the rental of telephones was about the only item considered, and the price, based on this, was placed at a very low figure.

After an existence of about two years, the business has been entirely revolutionized, and to-day the increased demand for exchange service, necessitating separate wires for each station, the best apparatus obtainable, and an enormous force of skilled operators and electricians, involves an outlay for operating expense alone, of more than double the gross rental originally charged.

Bearing in mind the fact that the service and not the rental is the chief item of cost, it must be apparent that the system of charges should be based on two items: 1st, the cost of lines and instruments without service; and 2nd, exchange service. In brief, that everyone should pay in proportion to service rendered.

In other words, from an association of a few individual subscribers the telephone exchange has grown into a gigantic local telegraph system, having now a thousand offices in this city alone, with a prospect that in two years more that number will be doubled.

To meet this change we propose to fix our rates solely on the basis of the number of messages sent from each station through the central exchange offices.

Necessarily a minimum amount of business must be guaranteed to cover the fixed charges which are independent of any service, but beyond that, we propose to make the message rates just as low as possible, depending for our revenue on a large increase in our message business. Our interest then becomes identical with that of the public. If we provide a large range of connecting stations, good instruments and attentive operators, our lines will be patronized accordingly: if instruments out of order, lines constantly "crossed," and the service poor, we will lose messages and the pay for them.

The rates established offer the cheapest telegraph service ever given to the public, but we believe that, with sufficient patronage, we can keep them down to the figures given; they do not affect existing contracts in any way.

Messages are charged to the sender only, no charge being made to the receiver, nor for the answer, if sent at once without a second call to our office.

It must be understood, of course, that these rates do not refer to messages sent between instruments on private lines, but only to those sent through our office.

The rate for transient messages sent by non-subscribers is ten cents, and all subscribers who have "message contracts" will be allowed to send such messages, and charge for them. In this way several parties can use a single telephone and the expense be very largely reduced.

For the benefit of our subscribers and the general public we sell tickets in packages of 12 for $1 at all of our offices.

These tickets are good for one city message at any public station. We will allow subscribers who receive these tickets for messages sent through their telephone, one message and two cents commission on each ticket returned to the general office.

It is impossible to give explanations in detail,. but we shall be glad to furnish any desired information by telephone, personally, or by letter, and we trust that the people of Buffalo, by allowing the company to build the lines necessary to supply their wants, and by patronizing those lines freely, will justify the adoption of the message system with low tolls. Yours respectfully.

EDWARD J. HALL, JR.,
General Manager.

It will, of course, be interesting to know how the public has responded. The answer can best be given by stating the present business of the exchange. Buffalo has, according to the last census, a population of 155,000 inhabitants. The present number of subscribers is not far from 1,500—say one to each hundred inhabitants. Of these, about 47 per cent. pay the minimum rate of $50 per annum; 36 per cent. pay from $55 to $95, both inclusive; and the remainder, or 17 per cent., pay from $100 to $210 each per annum, both inclusive. Thus it will be seen that, as compared with other cities, Buffalo has a large number of subscribers, and it is a matter of no little importance to add that the burden of expense is equitably distributed among subscribers according to the amount of use that they make of the telephone. The "dead beats" are entirely shut out, and much unnecessary and frivolous talk over the lines, which is inseparable from the arbitrary annual price system, but which nevertheless tends to impede and delay serious business, is entirely avoided. Of course, there are a number of public telephones in various places, which any one is free to use on payment of ten cents or a ticket. The message is charged to the calling station, and payment is received by the company either in money or the tickets deposited, or in both. As the persons who have these telephones get their messages at the reduced rates above given, the business on their premises is a source of revenue to them.

This, then, is the "Buffalo system," very simple to understand and very easy to keep in operation. Judging the tree by its fruit, it is safe to say that it is a success—that it is satisfactory to subscribers and remunerative to the company. More than all, it seems to be founded on justice alike to the company and to the subscribers, and it is perhaps for this reason, more than any other, that it has stood the test of experience so well.

The Buffalo exchange is only one of the sixteen exchanges belonging to the Bell Telephone Company of Buffalo, whose territory includes and covers Erie, Niagara, Wyoming, Genesee, Orleans, Monroe, and Livingstone counties, having in all 2,900 subscribers. Of these, over 500 have been added during the past ten months. It has a large trunk line business, sixty-two points in the territory being in intercommunication through them. It has a copper line between Buffalo and Rochester, and another between Buffalo and Niagara Falls, both of which are working very satisfactorily. These are single lines, grounded at both ends.

The rapid extension of trunk lines in this territory is due in a measure to the policy of the company in this matter. When application is made to the company for a trunk line, the parties applying are asked to buy books of coupon tickets, good for messages, at the rate of $100 worth of tickets per mile of line wanted. If they do this, the line is built and put in operation. Thus the applicants pay for the construction of the line in business which they guarantee to the company, but the line is the property of the company nevertheless.

The stock of this company is very firmly held, and seldom changes hands. That which is still in its treasury could be placed in an hour's time, were its issue necessary; but the company's policy of restricting dividends to six per cent., notwithstanding much higher earnings, has kept its treasury in good condition, with no need to part with its unsold treasury stock.

Telephonic News

*** The first telephone was placed in Leeds about October, 1879, and there are now in operation about 300 exchange and 40 private lines. This speaks well for the success obtained at Leeds, and especially so as new subscribers are added daily.

*** Mr. C. L. Boyce, manager of the Grand Rapids Telephone Exchange, Mich., has invented a cupola switchboard. The new system, on which Mr. Boyce will endeavor to obtain a patent, entirely does away with the matting and crossing of the wires in the cupola. The wires come in from the office poles in cables, and run perfectly straight, so that any wire can be tested, and, if necessary, cut without disturbing anything, and with the least possible trouble. Under the direction of Mr. J. S. Healy, the chief operator, the average service has been reduced to a minimum, and this city can show better time than any in the State, with an average of two seconds. Detroit averages from three and a half seconds to four. Eighty-four towns are in direct communication with Grand Rapids, and 235 miles of telephone wires are stretched within the city limits.

*** The visitor to the Electrical Exhibition will not be much confused after looking through the various telephonic exhibits if he attempts to determine who was the first to "transmit articulate speech by electricity." Nothing shows the gradual crystallization of scientific thought into practical service as well as does the study of the evolution of the telephone; and the fact that so many minds conceived, at or about the same time, the same idea is not so surprising as would be the solution of all the problems involved by a single inventor.

The kindred subjects of sound and electricity are each involved in the principles of telephonic communication, and it was by these two distinct paths that the two inventors, Gray and Bell, whose names are always associated with thoughts of the telephone, reached almost on the same day their practical results.

Elisha Gray, electrician of the Western Electric Company, had been engaged for many years in perfecting the harmonic system of multiplex telegraphy. His ideas were directed to this subject by a circumstance so trivial in itself, yet so full of remarkable results, that it is a model of scientific generalization. Whilst a tuning fork was vibrating in his laboratory, some children were amusing themselves in an adjoining room with a medical induction coil, with whose primary coil the fork was connected. Holding one pole in their hands, whilst the other was attached to the zinc lining of a bath tub, a sound was produced when they rubbed their dry fingers over the zinc lining. Gray was surprised to hear the same note that the tuning fork was giving forth. Repeating the experiment with another fork, he found that the sound was undoubtedly caused by the vibrations of the fork transmitted through the secondary coil of the battery. Gray immediately repeated in various ways this experiment; and finally evolved the Gray harmonic system of telegraphy. Page had discovered in 1837 that when a current surrounding an electro-magnet was interrupted a sound was given forth, and that when the current was interrupted regularly, at a speed varying from 16 to 4,000 times a second, that the magnetic core would give forth that musical note whose vibration corresponded to the number of interruptions of the current. This fact Gray utilized in his experiments, but he soon found that when a number of notes were struck in chord at one end of the line, and the circuit was connected or broken by a number of reeds, whose vibrations gave forth the sound, that they could be analyzed at the other end by passing the current about a number of electro-magnets whose armatures were formed by metallic strips of a definite length and tension. Each metallic strip would give forth a sound when the interruptions were in unison with the rate of its own vibrations, but would be silent to every other note. By this means he succeeded in transmitting over a single wire music which covered two octaves of notes, and many Philadelphians remember their delight when they heard music played at the Mayor's office reproduced perfectly on the stage of the Academy of Music. This exhibition was given in 1874 under the auspices of the late Mr. S. S. White, of Philadelphia, one of Mr. Gray's principal supporters in his experiments. This instrument was known as the electro-harmonic telegraph, and consisted of a series of organ reeds, in which were mounted the electro-magnets, each with its properly-vibrating strip of steel.

It was a long step from this invention to the attempt to transmit speech by similar variations in the strength of an electrical current, and nearly two years' experimentation had to be gone through with before it was accomplished. Finally, however, on February 14th, 1876, Mr. Gray filed his caveat at the Patent Office for his speaking telegraph. The instrument he used was sufficiently simple. Attached to a horizontal diaphragm was a wire dipping into water or other poorly-conducting fluid. This wire reached within a short distance of a similar wire projecting upwards. This apparatus formed a portion of the circuit of a battery, and the water in a state of quiescence offered a uniform resistance to the passage of the current. The other ends of the wire formed the coil of an electro-magnet whose armature was a vibrating diaphragm, to which was attached a small piece of iron, the whole being inclosed in a resonant chamber. When the diaphragm of the transmitter was vibrated by the sound of the voice, the water space, and consequently the resistance to the passage of the current, was alternately increased and diminished. This increased and diminished in like manner the attraction of the electro-magnet of the receiver, and vibrated the second diaphragm in exactly the same proportion as the first.

He filed his caveat for this invention on the 14th of February, 1876, but he was just two hours late. On the very same day Professor Bell filed an application for an exactly similar invention which he had reached by another path.

Professor Alexander Graham Bell, already well known to the scientific world by the investigations which he had made in conjunction with his father, Alexander Melville Bell, on the study of the sound of vowels, attempted, in 1875, the reproduction of the vowel sounds artificially by means of electrical tuning forks, and constructed an electrical harmonium which succeeded in this difficult object. It was this success which led him to seek the reproduction of articulate speech, and his instrument was even more simple than that of Gray. In his own words, he describes the electrical harmonium as follows:

"A harp with steel cords is attached to the poles of a permanent magnet. As soon as any one of these chords is set into vibration, an undulating current is produced in the coils of an electro magnet, whose core served as an armature to the permanent magnet; the corresponding electro-magnet of the receiving instrument attracts the chords of a similar harp with a variable force, and sets in vibration the chord which is in unison with the chord vibrating at the other end of the circuit. This is not all; the amplitude of the vibration in one of the chords determines the amplitude of the vibration in the other, for the intensity of the induced current is determined by the amplitude of the inducing vibration, and the amplitude of vibration at the end of reception depends upon the intensity of the attracting impulses. When we sing into a piano, certain chords of the instruments are thrown into sympathetic vibrations by the action of the voice, and, for different degrees of amplitude, an approximate sound of the vowel pronounced issues from the piano. Theory shows that if the piano had a much more considerable number of octave chords, the sounds of the vowel would be reproduced to perfection."

The line of thought which led to the construction of the telephone was now direct. His first instrument consisted of a diaphragm, to which was attached a small piece of iron, to serve as an armature to an electro-magnet. The receiver consisted of a hollow electro-magnet, whose armature was a thin iron disc fixed to the edge of the magnet at a slight inclination. This instrument was the one he patented, and showed to astounded audiences at the Centennial Exposition. Whatever may have been done previously, there can scarcely be a doubt that Bell, and, indeed, the whole scientific world, were unaware that speech had ever before been transmitted by electricity. The invention was original and startling in its novelty, and, as Sir William Thomson said at that time, it was the marvel of marvels of the nineteenth century.

The Telephone.

The telephone is a contrivance by which speech, uttered at one end of an electric circuit, can be heard at the other end, even though the circuit be many hundreds of miles in length.

When a bell is struck, the sound produced is carried to the ear of a listener by means of a wave motion, which the bell makes in the air around it.

Differences in sound are caused by differences in the rapidity with which these waves follow one another.

When sound waves, following each other with a certain rapidity, enter the ear of a listener, they produce therein equally rapid shakings, which, being carried by the mechanism of the ear to the brain, cause a sensation of sound corresponding to the peculiarity of the exciting sound waves.

In electric telephones it is not sound waves that are carried along the line; it is an electric current produced by the sound waves.

There are various kinds of electric telephones.

The magneto-electric telephone consists essentially of a contrivance called the transmitter, into which the speaker talks, connected by a conductor of electricity with a receiver, which the listener holds to his ear.

The atmospheric waves produced by the voice of the speaker, striking against the instrument, into which he talks, cause a plate of iron to move towards and from the pole of a permanent magnet, around which is wrapped a coil of insulated wire. An electric current thereby results, which, flowing over the wire, passes into the receiving instrument, and causes in it a movement that exactly corresponds to the movement produced at the transmitting instrument by the voice of the speaker.

A telephone, therefore, is a dynamo-electric machine driven by the voice of the speaker.

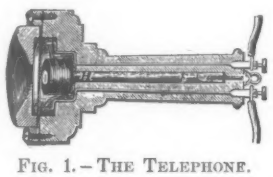


FIG. 1.—THE TELEPHONE.

The receiver is a dynamo-electric motor, whose rapidity of movements, exactly corresponding to the rapidity of the waves produced by the voice of the speaker, reproduces in the air around it the speaker's voice.

In Fig. 1 is shown, in section, a model of the Bell magneto-electric telephone. It consists of a magnetized steel bar, *F*, with a coil of insulated wire, *H*, wrapped around it near one of its ends. In front of the coil, so as to be able to freely vibrate to and from the pole, a circular disk of iron is securely fastened at its edges.

A conveniently shaped mouthpiece is placed over the plate, sufficient air space being left for its free vibration. If now a speaker talks into the mouthpiece, the vibrations of the air will cause the plate, which is magnetized by its nearness to the magnet pole, to move to and from the magnet. These vibrations produce in the coil an electric current that flows in one direction when the magnetized plate moves towards the coil, and in the opposite direction when it moves away from it. This instrument is called the transmitter. An exactly similar instrument may be employed for the receiver.

Fig. 2 shows how the receiver and transmitter are placed in circuit with each other.

Let *a* represent the transmitter, and *b* the receiver, and suppose them to be joined by a conducting wire.

This wire is represented in the figure as broken, so as to give the idea of distance. Suppose, now, a speaker talks at *a*; all he utters can be distinctly heard by the listener, whose ear is held at *b*.

The operation of the instrument is as follows: The effect of the speaker talking into *a* is to cause the magnetized plate to move with varying rapidity towards and from the coil on the magnetized bar. If we can cause exactly similar movements to be produced in the plate of the receiving instrument at *b*, a listener, whose ear is placed near *b*, will hear all that is spoken into *a*.

For, let us consider a single motion of the plate of *a*. Suppose that it moves towards the magnetic pole, and in so doing produces an electric current that flows out of the coil of wire at *a*, and into the coil of wire at *b*, through the ground. This current, circulating around the coil at *b*, causes the magnet to become more powerful, and so draw the plate *b* towards it. If, on the contrary, the plate at *a* moves away from the magnetic pole, the current flows from *a*, in the opposite direction, and, passing over the line, flows through the coil at *b*, weakening the magnetism, and thus permitting the plate, by reason of its elasticity, to move from the pole at *b*. The to-and-fro motion of the transmitter, produced by the speaker's voice, has been followed, therefore, by a similar to-and-fro motion of the plate of the receiving instrument, so that whatever is spoken at *a* can be heard at *b*.

In a telephone, therefore, it is not sound

FIG. 2.—MAGNETO-ELECTRIC TELEPHONE.

that travels along the wires—it is an electric current. The speaker's voice, acting on the transmitter, produces electricity, which, flowing over the line, reproduces similar movements in the receiver.

A magneto electric telephone consists essentially of a coil of wire wrapped on a magnetized steel core, and a plate of soft iron placed so as to be able freely to vibrate very near the pole on which the coil is wrapped, but without touching it.

Telephones are made of a variety of forms. In the case we have considered, the receiver is in all respects the same as the transmitter. In some forms of transmitters, such as the Blake, the current of a voltaic battery passes over the line through a resistance, which is varied by the voice of the speaker, so that the magnetization of the receiver is correspondingly varied.

In the electrostatic telephone, a system distinct in itself, invented by Dolbear, the speaker's voice varies the electric charge in two metallic plates placed near each other. These plates move towards and from each other when variations occur in their electric charge.—EDWIN J. HOUSTON.

The Western Union.

THE ANNUAL MEETING OF THE STOCKHOLDERS—PRESIDENT GREEN'S REPORT READ AND APPROVED—A SPLENDID FINANCIAL EXHIBIT NOTWITHSTANDING SOME DRAWBACKS—DIRECTORS ELECTED.

The annual meeting of the Western Union stockholders was held on Thursday last. The report for the year was submitted by President Green, and approved. It is as follows:

To the Stockholders:

The capital stock of the company is $80,000,000, of which $20,669 belongs to and is in the treasury of the company. A small portion of the capital stock is still represented by certificates of indebtedness in the hands of the Union Trust Company, in trust for the parties entitled thereto.

The bonded debt at the close of the year was as follows:

Bonds due March 1, 1900, 6 per cent....	$921,456.00
Bonds due May 1, 1900, 7 per cent	4,020,000.00
Bonds due May 1, 1902, 7 per cent	1,373,000.00
	$7,214,456.00
Less balance of sinking funds appropriations not yet used for redemption of bonds held by the Union Trust Company, trustees.....	290,162.87
	$6,924,223.13

During the year, sterling bonds due March 1, 1900, to the amount of £2,000, were redeemed by the trustees of the sinking fund; and the remainder of the bonds due May 1, 1900, amounting to $1,000,000, were issued.

Surplus July 1, 1883.....	$3,658,553.83
The revenues, expenses, and profits of the year ended June 30, 1884, were as follows:	
Revenues $19,632,930.60	
Expenses..... 13,022,503.90	
Profits.....	$6,610,435.70
	$10,268,989.53

From which there was applied:		
For dividends	$5,599,179.37	
For interest on bonds	472,350.27	
For sinking fund appropriations	39,991.00	
		$3,111,520.64
Deducting which, leaves surplus June 30, 1884, of		$4,157,468.89
Represented as follows:		
Surplus of net revenue for the year over dividends, int'st and sinking funds appropriations	$498,915.06	
Surplus at commencement of the year as above	3,658,553.83	
	$4,157,468.89	
The expenses for the year were:		
For operating and general expenses	$9,278,761.28	
For rentals of leased lines	1,842,689.66	
For maintenance and reconstruction	1,350,447.55	
For taxes	301,077 33	
For equipment of offices and wires	249,528.08	
Total expenses as above		$13,022,503.90

A classification of the expenditures is added to the usual statement, showing that all expenditures for reconstruction and repairs, rentals of leased lines, taxes, and the cost of all equipments, including those of new offices, have been charged, as usual, to current expenses before profits are ascertained. In reconstruction, larger and longer poles, capable of carrying more wires, are always used, adding materially to the original value of the plant. The cost value of the betterments of the lines, as well as the cost of instruments, batteries, and furniture for the equipment of new offices, might properly be charged to account of new property; but such has never been the practice of the company. Thus, the value of the plant is constantly being increased, the cost of such increased value being charged to current expenses. The gross earnings of the company show an increase over the previous year of a little more than $178,000, while the expenditures show a larger increase, owing greatly to the extraordinary expenses incurred in maintaining and operating the lines during the strike in July and August, 1883, the first two months of the fiscal year. How much the strike cost the company, in loss of revenue, can only be estimated; but its cost in extraordinary expenses was nearly, if not quite, half a million of dollars. It is believed that, but for the interruptions to business and the extraordinary expenses occasioned by the strike, the gross revenues would have been over twenty millions, and the net profits above seven and a-half millions of dollars. But in spite of this drawback, and notwithstanding the fierce competition for business between the principal commercial centers, and the general reduction of rates, the net profits have paid on the outstanding stock 7 per cent. dividend, amounting to $5,599,179.37; $512,341.27 for the interest and sinking fund; and added a balance of $498,915.06 to the general surplus.

GENERAL STATEMENT.

The following exhibit shows the revenues and disbursements of the company for eighteen years from July 1, 1866:

Surplus of income account, July 1, 1866	$275,357.24	
Net revenue for eighteen years, from July 1, 1866, to June 30, 1884	72,379,736.98	
Making an aggregate, June 30, 1884, of		$72,655,004 22
During this period there was applied:		
For cash dividends to stockholders (including dividend payable July 16, 1884)	$39,130,704.17	
For cost of 59,606¼ shares of Western Union Telegraph stock, purchased and owned by the company, which was distributed to stockholders in 1879	3,302,198.90	
For cost of 72,010 shares of Atlantic and Pacific Telegraph stock, purchased and owned by the company, the proceeds of which in Western Union stock were distributed to stockholders in 1881	1,806,250.00	
For interest paid on company's bonds	7,200,730.59	
For cost of 396 4¼-100 shares of Western Union stock, purchased and owned by company, which were canceled to make the capital stock after the issue of the new stock in 1881, exactly $40,000,000	26,896.00	
For amount reserved for interest on bonds and for sinking funds, accrued to June 30, but then not yet due and payable	106,086.64	
		$51,572,806.30
Leaving a surplus of		$21,082,287.92

Which is represented as follows:		
Construction of new lines, erection of additional wires, patents, etc	$9,402,015.08	
Purchase of telegraph lines, and of the stocks of companies leased by the Western Union Company, upon which interest or dividends are paid as rental	2,448,182.66	
Gold and Stock Telegraph Company's stock (18,905 shares)	1,176,000.00	
International Ocean Telegraph Company's stock (15,170 shares)	961,606.42	
Brooks Underground Telegraph Company's stock (1,000 shares)	95,000.00	
Southern Bell Telephone and Telegraph Co.'s stock (1,687 shares)	84,325.00	
Sundry other stocks and bonds	93,739.68	
Western Union bonds, redeemed and canceled	1,379,694.27	
Sinking funds (portion not yet used for redemption of bonds, exclusive of interest allowed by trustees	260,765.82	
Broadway and Dey Street building $2,365,639.52		
Less am't provided from the proceeds of the bonds. 1,802,202.00	563,437.52	
Real estate, other than above	277,753.50	
Supplies and material on hand unissued	182,290.08	
Surplus, June 30, 1884	4,157,468.87	
		$21,082,287.92
On account of these assets a stock distribution was declared in 1881, to the amount of	15,526,590.00	
Deducting which, leaves a balance of		$5,555,697.92

Of the surplus, June 30, 1884, $4,693,495.23 have been advanced to the account of construction and investments in real estate and other new property, besides the proceeds of $1,000,000 of bonds sold and applied to that account, and not otherwise appearing in the accounts of the company.

It had been resolved that from and after October 1, 1881, expenditures for the construction and purchase of new lines, and other additions to the plant, should be provided for by the sale of assets in the treasury, thus converting one valuable asset into another, considered to be more valuable and more directly in the line of the business of the company, and leaving all the net revenues above fixed charges available for dividends. But this has not been done. The sale of some of our stocks in telephone companies was contemplated, but the price offered was so disproportionate to the dividends which they were earning that no sales have been made. The company, having a considerable surplus above its dividends and fixed charges, has continued to advance the requisite funds for construction and the purchase of new property. These advances are regarded as a constructive loan, which may be recouped to the treasury for dividends whenever the original order may be satisfactorily carried out by the sale of the securities at what may be deemed a fair valuation.

Of the $39,130,704.17 paid to stockholders in dividends during the last eighteen years, as appears in the foregoing general balance sheet statement, $17,996,776.83 have been paid in dividends during the last three and one-half years, since the consolidation of January, 1881; and, in addition thereto, $4,693,495.23 have been advanced and paid within the same period for new and additional properties, making an aggregate of $22,690,272.06 paid out of the net revenues of the company since the date of its present capitalization, and within three and one-half years.

Representing this outlay, besides the real estate, telegraph stocks and bonds that have been acquired, the annexed table shows additions of nearly 35,000 miles of lines, over 122,000 miles of wire and 3,700 offices, within the past three years, whilst there has been an increase during the past year over the year ended June 30, 1881, of 9,500,000 messages sent, and in gross receipts, $3,250,000, and in net profits, $1,700,000.

The statistical tables are made up only for each entire fiscal year ending the 30th of June, therefore the increase during the first six months under the present capitalization (from January to July of 1881) cannot be shown therefrom; but the increase of the past three years alone, made with an outlay of five and a half millions of dollars, the greater part of which was paid out of surplus profits, shows an additional mileage of line and wire greater than all the competing companies claim to have, while the number of additional offices and amount of increased business and revenues are probably double that which they can unitedly exhibit.

These additions to the plant, representing a cost value of probably twelve millions of dollars, were not acquired solely by the cash outlay before stated. Some were leased with purchases of a portion of the stock and bonds they represented; some were purchased outright, at about their cost value; and a large portion were constructed directly by the company, as is its custom, purchasing the material of the lowest bidder, and hiring the labor, without paying profits to intermediate contracting companies.

The company has no floating debt, and its salable assets in the treasury, allowing for the probable shrinkage in market value of some of them in sympathy with the general decline during the past year, are believed to have an aggregate market value of at least nine millions of dollars, with a probability that many of the securities will greatly enhance in value with the rapid growth of the telephone business.

STATISTICS.—*The following table exhibits the amount of lines operated, number of offices, number of messages sent, receipts, expenses and profits for each year since* 1866.

Year.	Miles of Poles and Cables.	Miles of Wire.	Offices.	Messages.	Receipts.	Expenses.	Profits.
1866	97,380	75,086	2,250	5,879,282	$ 6,568,925 96	$ 3,944,005 63	$ 2,624 919 73
1867	46,270	85 591	2,595	6,404,595	7,004,560 19	4,862,749 32	2,041,710 87
1868	50,181	97,394	3,219	7,394,993	7,310,918 90	4,568,116 85	2,742,801 45
1869	52,060	104,384	3,077	7,197,646	7,138,797 96	4,910,772 42	2,227,965 54
1870	54,109	113,101	3,972	10,646,677	7,697,448 85	5,114,787 19	2,582,661 66
1871	55,032	121,151	4,606	12,444,499	8,457,095 77	5,666,803 16	2,790,292 61
1872	62,089	137,190	5,257	14,456,832	9,393,018 51	6,575,055 82	2,737,962 69
1873	65,757	154,472	5,570	16,329,236	9,262,633 98	6,755,795 88	2,506,820 15
1874	71,585	175,735	6,188	17,158,710	9,564,574 60	6,395,414 77	3,229,157 83
1875	73,893	179,496	6,505	18,720,567	10,091,963 66	6,685,473 69	3,399,509 97
1876	76,955	183,892	7,072	21,138,941	9,812,532 61	6,672,284 94	3,140,247 67
1877	81,002	194,393	7,500	25,918,894	9,987,3525 53	6,309,812 53	3,351,542 70
1878	82,867	206,202	8,014	25,070,106	10,900,640 46	6,100,200 57	4,800,440 09
1879	85,645	211,566	8,534	29,215,509	12,782,804 53	6,946,906 74	5,835,957 79
1880	101,340	253,354	9,077	32,500,000	14,393,543 85	8,483,264 13	5,908,279 72
1881	131,060	327,171	10,737	38,842,247	17,114,105 92	9,996,015 92	7,118,070 00
1882	274,988	432,726	12,017	41,181,177	19,454,502 98	11,794,553 40	7,660,348 58
1883	144,294	450,571	13,761	42,070,226	19,682,1959 60	13,022,503 90	6,610,435 70
1884	145,057						

Deducting from the gross revenues the earnings of the Atlantic and Cuba cables, the Gold and stock commercial news and quotation earnings, the dividends received on stocks in other companies, and from other sources than tolls on messages transmitted over the land lines; and eliminating from the gross expenses the rentals paid for ocean cables and for the Gold and Stock Company, and the cost of operating these properties, the average rate collected per message was 36½ cents, against 38 cents collected during the previous year, while the average cost of transmission and delivery was a fraction over 25 cents per message, being about the same as for the year previous. But the average cost was increased by the extraordinary cost of conducting a limited amount of business during the existence of the strike.

It is confidently believed by the management that we shall be able to maintain our revenues for the ensuing year; and that with a material reduction of expenses, yielding a handsome increase of net profits.

Nevertheless, in view of the continuing necessity of extending lines and adding wires to meet the growing demand for leased wires; and especially in view of the probable forced sale of a considerable amount of telegraph properties which may be purchased for much less than the cost of its production, it is recommended that dividends be hereafter confined to the rate of 6 per cent. per annum, and a cash surplus accumulated in the treasury.

NORVIN GREEN, President.

TELEGRAPHIC

.... In consequence of political troubles, telegrams for Peruvian offices, other than Chorillos and Molendo, are only accepted, subject to delay and at the risk of the sender.

.... According to advices received by the Eastern Telegraph Company, under date of September 3d, telegraphic communication with Tien-Tsin and Pekin has been stopped by the interruption of the Chinese land lines beyond Chining.

.... The Mutual Union Telegraph Company issued an order last week making the rate from New York to Hartford, Providence and Boston 15 cents for 10 words, and one cent for each additional word. This meets the Baltimore and Ohio rate of twenty words for 25 cent.

.... The report of the Post and Telegraph Administration of Lower Austria shows for the telegraph department a net profit of 1,281,292 florins (£128,130) for 1882, and of only 1,013,478 florins (£101,350) for 1883. This falling off is accounted for by a diminution in the number of telegrams, which was 947,814, or 42,040 less than in 1882. On the other hand, the number of messages sent by pneumatic tube has greatly increased.

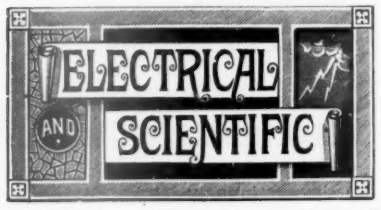
.... A deputation of the inhabitants of Upper Hastings and Manning, in New South Wales, Australia, has presented a petition to the Director-General of Posts and Telegraphs, demanding the prompt establishment of telegraphic and telephonic communication with Sidney, the want of which has been much felt. The director-general has promised to do all in his power to satisfy the wants of the inhabitants.

.... The Direct United Cable Company notifies that the £100,000 six per cent. debenture loan of the company, falling due on the 15th October next, will be repaid on and after that date at the Consolidated Bank (limited), 52 Threadneedle street, London, E. C., together with the interest then due. The debentures, which will cease to carry interest from 15th October next, must, with coupons attached, be left for examination at the Consolidated Bank three clear days prior to application for payment.

.... At the regular meeting of the directors of the Postal Telegraph and Cable Company, held on Friday last, Henry Cummins tendered his resignation as director and general manager. F. M. Gillett was elected director in place of Mr Cummins Henry Rosener was elected second vice-president and general manager. George S. Coe, first vice-president, made a statement to the board setting forth the present favorable condition of the company.

The Postal and the Bankers and Merchants' Telegraph companies have reduced rates to Boston, Providence, Fall River, Hartford, Newport and Waterbury to 25 cents for 20 words, and 1 cent for each additional word. These companies say they are acting independently of the Baltimore & Ohio.

.... *Iron Age* gives an amusing incident in connection with the laying of the underground cables in Washington. The receptacle for the wires had been laid for four squares and covered over very carefully, when it was discovered that no wires had been placed in the receptacle, and the whole thing had to be taken up. As a companion piece, a Washington telegraph manager tells of a similar incident which happened in London many years ago. One of the lateral wires connecting with an underground cable had been drawn out for repairs without attaching a leading line to it by which it could be drawn through again. In this case the remedy consisted in fastening a fine steel wire to a large rat and setting him at liberty in the pipe. A ferret was started in after the rat, and the latter ran the entire length of the pipe, bringing the wire with him.



* * After the summer of 1885 science will take equal rank with Greek and higher mathematics in the examination of candidates for admission to the Royal Military College, Sandhurst, England.

* * Scientific works by Agassiz, Buchner, Huxley, Lubbock, Lewes, Moleschott, Reclus, Adam Smith, Spencer, Vogt, Zimmermann have been added to the list of those already prohibited by ukase from circulation by libraries in Russia.

* * The Electrical Conference at Philadelphia approved the suggestion made by Mr. W. H. Preece in his paper before the British Association at Montreal, that the horse-power be raised to the equivalent of 1,000 watts, or 44,000 foot-pounds.

* * At St. Louis a model electric elevated railroad, run by a new motor invented by Dr. W. F. Adams, was put in working order at the Exposition Building last week. The power is distributed from a central station, and runs along a wire laid under the car track, similar to the cable of a cable road, and gripped in a similar manner.

* * Recently the dome of St. Peter's, in Rome, was reclad at an expense to the Vatican of $40,000. The old sheathing required such continuous repairs that it was deemed better to replace it. The sheets of lead which now cover the dome weight 708,610 pounds, and would extend over more than an acre and a-half of land if they were spread out flat.

* * "Suppose," said an examiner to a student in engineering, "you had built an engine yourself, performed every part of the work without assistance, and knew that it was in complete order, but when put on the road the pump would not draw water, what would you do?" "I should look into the tank and ascertain if there was any water to draw," replied the student.

* * Some time ago M. d'Abbadie proposed in the French Academy of Sciences the adoption of the term *megiste* to represent the fourth part of the terrestrial meridian, or a length of 10,000 kilometers on the French metric system. In order, however, to have a term more in accordance with the nomenclature of the multiples and sub-multiples employed to-day by electricians, M. Hospitalier has made an amended proposition to the effect that the word megameter should be used instead.

* * An interesting experiment has been successfully tried in Berlin. A basket is provided containing a nest of hay, closed by a well-adjusted covering and provided underneath with a thick pillow, which contains a metallic spiral. A battery of six cells, in a neighboring room, furnishes the electricity for warming the spiral, the current passing through a lever regulator. As the temperature should be kept constant, a small thermometer is inserted, with the bulb in the nest and a fine platinum wire soldered into the tube. When the temperature becomes too high, the mercury touches the wire, forming a contact which throws the apparatus out of circuit. When it cools again, the current is restored and the temperature raised.

* * The Bidwell Electric Railway at the Electrical Exhibition is now in good working order. The car is propelled by electricity and the same power also lights the incandescent lamp in the car and the arc lights along the railroad. The electric current is taken from a dynamo which can be run by either steam or water power, and conveyed to the tubes which carry the current along the railroad. A small wheel runs in the tubes and takes the current to the motor in the car. It is a very simple process and is a grand success. The model on exhibition is designed for an elevated railroad, and is just the thing that Philadelphia needs.

An official of the Commercial Cable Company says that the Faraday had just arrived at Nova Scotia with the second cable. This leaves only the line from Canada to Coney Island unfinished.

New Zinc Accumulator.

One cannot help being a little amused at the way in which inventors are continually ringing the changes on secondary battery arrangements. M. Reynier has lately devised a zinc accumulator, which has, to use the usual formula, given good results. It comprises four large Plante positive electrodes, bent and perforated, and three negatives, consisting of smooth lead plates, which are coated with zinc by electro deposit from an acidulated solution of sulphate of zinc, in which the element is immersed. Glass tubes attached to the negatives by lead wires prevent accidental contacts inside the battery. The seven electrodes are carried by as many separate cross bars, made of paraffined wood, which rest on the edges of the cell, and keep the plates at a certain distance from the bottom. The place of a cover is taken by these cross bars, which touch one another. Each plate is provided with a terminal, the four positive poles being on one side and the three negatives on the other; and two brass rods, terminating in binding screws, connect the poles of the same name. The cell consists of two wooden rectangular boxes, one inside the other, with a space of several millimeters between, lined with a water-tight cement, supple and non-conducting, of tar base. The complete insulation of the case, and of all the parts, the purity of the metal deposited, and its amalgamation, are said to reduce to a minimum the local attack on the zinc, which was considerable in the old Nantua battery. The consequence is that what is called the *co-efficient of restitution* may now be compared with that of the Plante accumulators. The following are the leading particulars of the new accumulators:

E.M.F.	2.36 volts.
Mean resistance	0.02 ohm.
Normal intensity of discharged current	25 amps.
Intensity of charged current	5 to 10 "
Capacity of accumulation after 200 hours of formation	550,000 coul.
Effective surface of the four positive electrodes, (3,100 sq. in)	200 dm².
Effective surface of the three negative electrodes, (2,015 sq. in.)	13 "
Weight of positive electrodes, (18 lbs.)	8.2 kg.
Weight of negative electrodes, (3 lbs.)	1.4 "
Weight of the cell (6 lbs.)	2.7 "
Weight of the fluid (10 lbs)	4.4 "
Weight of the lead wires, (1 lb.)	0 46 "
Total weight (38 lbs.)	17.16 "

The total amount of electrical force stored up is 130,000 kilogrammeters (950,000 foot-pounds), or 7,600 kilogrammeters (55,000 foot-pounds), per kilogramme (2.2 lbs.) of accumulator. Theoretically, a zinc accumulator should store up double that amount; and if this form gives less, it is—at least so it is said in *Les Mondes*—because M. Reynier has designedly increased the strength of the cell and the bulk of the electrodes beyond what is necessary. It should also be remarked that this capacity of 7,600 kilogrammeters per kilogramme is higher than that of any accumulator hitherto made in France. Therefore, notwithstanding the great weight of the cell and the positives,—this new form of accumulator is relatively light, which renders it suitable for use in electric locomotives, as well as in fixed plant. Independently of their use as accumulators, zinc secondary batteries may be utilized as "regulating voltameters" in incandescent lighting, and for counteracting irregularities due to the piston stroke, accidental stoppages, and other causes.

A new telegraph system is in course of construction at Tripoli from the frontier of Tunis on the one hand to Egypt on the other.

Signal Indicator Apparatus.

With the ever-increasing development of railway traffic, the enormous multiplication of trains and the general complexity of fast and slow traffic on the same rails, there is obviously absolute need for the most perfect system of automatic signaling attainable. Very much, as we all know, has been done in this vital direction—one so greatly affecting life and property—but there was still room for improvement, and especially in regard to means for indicating to railway travelers the names of the various stations as the train approaches them. Mr. Henry Botten, of 113 Grove Road, Victoria Park, London, has recently invented a signal indicator apparatus which appears to possess very positive merits of its own. This invention is carried out in three ways. The object in view is effected mechanically, pneumatically and electrically, and each system is remarkable for its great simplicity.

In the electrical arrangement the mechanism consists of a spindle, to which a step-by-step revolving motion is given. On the spindle is fitted a pointer, to be brought opposite to any point on the dial plate. A lever arm standing out from the spindle of the escapement lever is coupled by a link to the longer arm of a lever, the shorter arm of which is coupled by another link to the armature of an electro-magnet. The armature moves on a spindle at one end, whilst at its opposite end it is linked to the shorter end of the lever, as above explained. In this way the escapement lever may be rocked through a considerable arc by a comparatively small movement of the armature. A bell to call the attention of those in charge can be fixed over the indicator. Whenever a current is passed through the coils of the electro-magnet, the armature is attracted, and the toothed escapement wheel is, by the action upon it of one arm of the escapement lever, turned a distance equal to half the distance between the teeth of the wheel; and when the current is interrupted, and the armature drops, the escapement wheel is turned another half tooth, and there locked by the weight of the counterpoise, thus bringing the pointer into a line with the figure upon the dial plate The transmission of the electric currents to the coils of the electro-magnet may be controlled by an ordinary finger key make-and-break contact apparatus, there being only two insulated wires used to any number of signals.

In the arrangement the motive power is air, constant air in its normal condition being the only agent employed. A small vulcanized india-rubber air chamber, specially prepared, is used to compress the air along the tube to the communicator and indicator. One tube only being used for any number of signals or orders, the transmission of the air from the chamber to the apparatus is practically instantaneous. If the runs are over one or two hundred feet, a portable fixed air pump is used, which is worked by leverage. The india-rubber air chamber is protected by the ordinary wood, metal or porcelain cover, with a plunger projecting through the front, with a metal plate screwed on the inner end to compress the rubber bag or air chamber. The metal composition tube can be protected by an iron tube to avoid damage. The motion is exactly similar to that of the electric system, and the mechanism works so freely that every reliance may be placed on this method of working. A counterpoise rests on the metal top of the bellows or air chamber. When the communicating of bellows or air chamber is pressed with the slightest exertion, it presses the whole column of air through the tube and expands the bellows, forcing up the lever, and the toothed escapement wheel is, by the action upon it of one arm of the escapement lever, turned a distance equal to half the distance between the teeth of the wheel, and when the air recedes, and the counterpoise falls, the escapement wheel is turned another half tooth, and there locked by the weight of the counterpoise, thus bringing the pointer in a line with the signals marked on the dial plate.

We understand that briefly the special advantages of Mr. Botten's system of telegraphs are its unvarying condition of perfect readiness and the extreme simplicity and extraordinary facility wherewith it can be fitted and worked, added to which its cost is very low. Its only agent is electricity, which is transmitted through only two insulated wires to any number of signals, which can be cased or protected by running them through a half-inch iron tube. The communicator can be fixed on the slightest partition of the chart-house of a ship or on the table, there being no power or strain required to work it. The communicator can be so constructed that it has one dial inside and one outside the chart-house, so that it can be worked inside or out, and the key fixed at any convenient place. The mechanism gives a rotary motion, which enables the whole of the circumference of the dial plate to be used for making the signals or orders prominent and distinct. In fitting up this system, only a small hole is required to be drilled through the bulk-head or deck, which can be packed water-tight after the wire has been passed through. There are, too, no screws nor springs in the working parts, and it is worked by the simplest and most lasting battery known, namely, the Leclanche, which remains effective for from fifteen to eighteen months.

Note on the Periodic Modification of Electrostatic Induction.

In continuation of my magnetophone experiments of a year ago, I have applied the perforated metallic disc to static electricity for the production of sound. For this purpose a "static telephone" was needed, and I have to thank Professor Dolbear for kindly placing one at my disposal.

A thin zinc disc, perforated with a circle of 24 half-inch holes, was mounted on a rotation apparatus, and placed near a Holtz machine, so that the brass ball of the positive electrode was very close to the circle of holes. On the other side of the disc was placed another ball, insulated and connected with one of the plates of the static telephone. The other plate was joined to earth. Upon working the machine, and turning the perforated disc, a musical note could be plainly heard after the telephone had become charged by a spark from the machine passing through a hole in the disc. The disc itself was not insulated. The Holtz machine could then be stopped, and the sound remained audible as long as the brass ball retained an appreciable charge. In this case the lines of static induction pass through the holes, and the ball connected with the telephone is acted upon inductively. The solid portions of the disc intervening, on the other hand, screens the ball from the inductive action. Hence a periodic modification of the induction taking place between the two balls, and a corresponding movement of the plates of the static telephone by an increase and decrease of attraction, thus giving rise to a musical sound.—*H. J. Carhart.*

Race Between Two Electrical Launches.

A new electric launch, the "Australia," has just been completed and launched from the wharf of the Electrical Power Storage Company at Millwall. The hull of this launch has been built by Messrs. Forrest & Sons, to the order of Messrs. Stephens, Smith & Co. engineers, for an Australian firm. She is of mahogany; length 25 feet, beam 5 feet 7 inches, and she can carry sixteen persons comfortably. The motive power consists of electrical power storage accumulators, placed as ballast at the bottom of the boat, and a Reckenzaun electro-motor, driving a two-bladed gun-metal screw of 18 inches diameter and 11 inches pitch. The Reckenzaun motor weighs 390 pounds, and is capable of working up to 6-horse power mechanical, but ordinarily it will be worked at a lower rate in this boat—at the rate of 5 electrical horse-power. Weather permitting, a competitive trial trip will take place on Saturday next, at two o'clock, from Millwall to Charing Cross Pier and back to Greenwich, the competing launch being the well-known boat "Electricity," which caused some sensation when launched in September, 1882. This launch was designed at the time by Mr. A. Reckenzaun, for the Storage Company.

She is of iron, 25 feet long, and only 5 feet beam. A set of electrical power storage accumulators supply the current to a Siemens D2 dynamo, weighing 658 pounds. The screw is of steel, made by Messrs. Yarrow & Co, 18 inches diameter and 11 inches pitch, and which screw formed a pattern for casting the one in the new launch. It will be arranged that during the trial both machines shall be supplied with the same amount of energy, viz., 3,730 watts, or 5 electrical horse-power.

An Electric Sounding Apparatus.

Sounding is often to the seaman an operation of a life and death nature, and is always a matter of great importance. Too often, however, it is performed in a perfunctory manner, and more often still is neglected altogether, or postponed until it is too late to avert the very consequences it is especially designed to prevent, and many a vessel is fatally stranded or strikes a rocky bottom simply because soundings were not taken in time. In casting the lead too, by human agency, there is great liability to error, and those experienced in such matters assure us that in cold weather a man sounding cannot in many cases really tell whether the bottom has been touched, although the safety of both cargo and crew may entirely depend on promptly ascertaining the depth of water immediately about the vessel. There is another consideration, all important indeed in these times, and that is, that for iron ships grounding on a hard bottom or striking a rock is in these days very quickly fatal. Iron plates do not hold together with the tenacity of timber, and thus it follows that catastrophes due to sudden shoaling are sudden and terrible. We have often thought that some application of science might be found to the great improvement of sounding so as to give the operation more certainty and to eliminate thence those defects which are so often cruelly accentuated by some supreme disaster off shore. This great desideratum, for it is nothing less, has just come before us in the shape of an electric sounding apparatus, which is as simple as it is ingenious, and as automatic as it is unerring. The apparatus in question is the invention of Mr. William Balch, of Greenwich, and has been exhibited at the Crystal Palace Exhibition, where it first came under our notice. It is only the ordinary deep sea lead arrangement connected with an electric wire and battery, and so disposed that the very instant the lead touches the bottom a bell sounds on board and rings the alarm with a certainty that is too generally absent when sounding is left entirely to human agency. It is at once obvious that in an invention like this, we have absolutely the means for preventing the whole series of disasters due to sudden shoaling, to the effect of fog and mist in hiding the coast, to neglect of, or delay in sounding, and in a word to all other of the sad mischances that beset the mariner who is once stranded. The lead can be hove overboard long before the vessel is out of depth, and Mr. Balch's admirable application of electricity quietly and confidently left to do its work. It is absolutely trustworthy. The bell, too, may be multiplied with the utmost ease into many bells, sounding not only in the captain's cabin, but in the cabins of the officers, and in other parts of the ship. Thus guarded, a big ship may glide on through thick mists in perfect safety, so far as stranding is concerned, for the lead thus electrically connected will ring out its ten fathoms, or whatever depth it may be set at, with inexorable precision, and mistakes, such as those frequently made in hand sounding, so frequent in cold weather when the men's hands are numbed, are made simply and absolutely impossible.

We certainly conceive this invention to be of the very greatest importance to both the mercantile marine and the navy. Without doubt the attachment and employment of this electric sounding apparatus to the Wasp would, in all probability, have averted a lamentable catastrophe, and saved the country the lives of those brave men who came in a moment to so cruel an end; also the grounding of H. M. S. Alexandra, when going up the Dardanelles, would by this invention have been avoided. The great merit of this admirable application of electricity to sounding is very obviously its certainty, precision, and entirely automatic character. It is, in truth, in our opinion, precisely one of those inventions of which the use ought to be compulsory on board every vessel, and it only needs a passing reference to the wreck register—that black record of the fatalities around our coasts—to perceive how many ships are lost entirely through stranding—a disaster always more or less serious and very often fatal, more especially, as we have remarked above, to iron vessels. Finally, we would add that this apparatus is in no way costly. The addition of the wire and battery to the ordinary lead is but a small matter, *per se*, and yet it is decidedly no small matter to have here an absolutely certain means for sounding effectively, at the particular time when sounding or not sounding may make just the difference between safety and shipwreck.

In the very splendid armory of Turin, amongst war-like implements of all sorts and of all ages, surrounded by warriors armed *cap-a-pie* on prancing steeds (stuffed), there is to be seen, in a glass case, a piece of the old Dover-Calais cable which had been presented to the King of Italy years ago. It is carefully labeled, and its weight is recorded in a corner of the label. Probably the donor or the museum authorities thought that the merits of the sample, about a foot long, were commensurate with its weight.

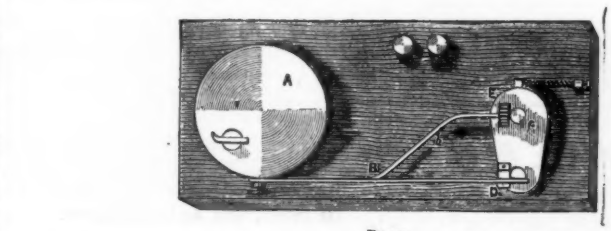
With a special 33-day clock train it is said to be a very efficient meter, indicating exactly the energy expended in a lighting circuit in a month, with the advantage of enabling the consumer to check waste, and actually see for himself the cost of his installation day by day, the instrument being enclosed in a locked case, having a plate glass front.

The distribution of standard time by electricity is rapidly gaining in popularity, and promises to be very general in the future. The company furnish and set up their dials where wanted at a moderate fixed rate per month, and they require no attention whatever from those who hire them. In all offices, public halls, and many other places where it is desirable at all times to have absolutely correct time, the standard time can be furnished for a trifle more than the annual interest on what a really good clock would cost, to say nothing of attendance and repairs. The clocks now used in church towers are, in many cases, gigantic pieces of machinery, requiring heavy expense for maintenance, and constant watching to keep them right. Again, the initial cost is very great. The substitution of an electric dial, without expense, except for rental, with no care necessary to keep it accurate, no winding and no repairs, is so palpably a step in the right direction that its general adoption cannot long be delayed.

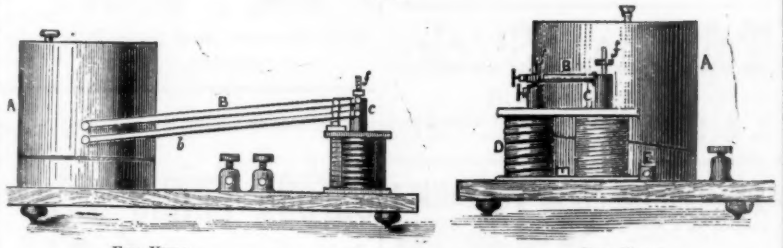
From almost every point of view the Electrical Exposition, just closed, has been eminently successful. It has more than paid its cost, something rarely seen in exhibitions. It concentrated under one roof all the practical results of recent thought and invention in electrical science and afforded opportunities for observing them under the best possible condition. The exhibition was open thirty-four week days.

The public is shown to have appreciated the exhibition by the numbers who have visited it. The estimated total of visitors is 300,000. Of these during the last week the daily attendance averaged 14,000, the largest attendance on any day being on Thursday, when the turn-stiles registered 16,624. The smallest attendance was during the intensely hot weather, on September 5, when only 2,658 people passed through the gates. The management state that all expenses have been fully covered and a surplus remains. In round numbers the receipts amount to $100,000, of which $90,000 has been paid away in general expenses, leaving $10,000 profit.

Ottawa, Ontario, is to be the first in the Dominion to be entirely lighted with electricity, and the gas and naphtha lamps now in use upon the streets will be discarded as soon as the contract with the Royal Electric Company of Montreal, awarded by the City Council, can be carried into effect. Power for running the dynamo machines will be taken from the inexhaustible supply of Chaudiere Falls, and the system employed will be that so favorably known wherever introduced by the American Electric and Illuminating Company, to whose Canadian business the Royal Company is successor. The obtaining of this contract by the Royal Company in the face of strong competition is a noteworthy triumph, both for the company and the system.



PLAN.



END VIEW. SIDE VIEW.

WALKER'S ELECTRIC ENERGY RECORDER.

Walker's Electric Energy Recorder.

This instrument consists of a cylinder, A, which carries the paper for the diagram, and which is rotated by clockwork contained within it. Two solenoids, D and E, have movable cores, C, C^1, which are kept in position by suitable spiral springs inside the bobbins. One of these, D, is wound with thick wire, and the whole current of the circuit to be tested or measured, passes through it, while E is wound with fine wire of high resistance, and forms a shunt from the main circuit. The magnetism induced in D, tending to draw the core into the solenoid against the tension of the spiral spring, depends, of course, upon the current strength, and similarly the movements of E vary as the E.M.F. Two levers, B, *b*, carrying pencils, or self-inking styles, multiply and record the movements of the iron cores of the solenoids upon the revolving paper upon the cylinder, A.

The levers can be adjusted to zero by means of the milled nuts, *f*, *f*, the springs being changed to suit the requirements of the test to be made. Thus the horizontal line of zero for B can be adjusted always above *b*.

This instrument is claimed as being very useful for automatically recording the efficiency of primary or secondary cells, the diagram being the true characteristic curve, and the sum of the two curves at any ordinate, being the electrical energy of the generator under test at that time. Scales are provided with each spring, so that the diagram is worked out in exactly the same way as one drawn by an ordinary steam engine indicator.

ELECTRIC LIGHT NEWS

—— The Rheinische Elektricitäts Gesellschaft has introduced an improvement into its differential solenoid lamps by adding to them a variable resistance, which has the effect of regulating the intensity of the current in the shunt circuit, and a resistance coil, introduced automatically, for compensating the resistance of the lamp when the latter is switched out of circuit.

—— Local companies using the Weston Arc System are successfully operating Central Stations, supplying a large number of lights for rental, at Boston and Springfield, Mass., Manchester, N, H., Providence and Newport, R. I., New York City, Rochester, Elmira and Glens Falls, N. Y. Newark, Cape May and Atlantic City, N. J., Philadelphia, Lancaster, Philipsburg and Allentown, Pa., Baltimore, Md., Washington, D. C., Charleston, S. C., Houston, Dallas, San Antonio, Texas, Louisville and Lexington, Ky., Toledo, Ohio, South Bend, Ind., Moline, Ill., St. Paul, Minn., Dubuque and Sioux City, Iowa, Omaha, Neb.

—— At New Bedford, Mass., the Sawyer-Mann Electric Illuminating Company, of New York, has just placed a 100-light plant in the tack factory of the Thayer & Judd Company on Front Street. The light is incandescent, and the burners are almost identical with those of the Edison light, the only apparent difference being a twist in the carbon, giving it something the form of a figure eight. The lamps are of twenty candle-power, and about seventy-five are already in. The system works very satisfactorily, and no increase in power is required to operate the dynamo. Other lights are to be added to the full capacity of the plant. The work has been done under the supervision of Mr. J. H. McLean, electrician.

—— Dr. R. W. St. Clair, of Brooklyn, has connected a small incandescent lamp with a portable electric battery. The apparatus is intended to be used in surgery for the illumination of cavities in the body. Many operations in surgery are difficult or impossible on account of the impossibility of lighting up the cavity to be operated upon. With this instrument, combined with the laryngoscope, the throat may be explored to a greater depth than heretofore has been deemed possible. The lamp will be very useful also in dental surgery. It is very small—hardly larger than the head of a pencil. It has even been proposed to use the light for the purpose of photographing cavities of the body. The whole apparatus is about the size of a cigar.

—— Carbons for arc lights are formed by thoroughly incorporating a mixture of finely divided carbonaceous materials, such as the purer forms of coke, or gas retort carbon with some liquid substance, such as oil, tar or sugar syrup, that, when subjected to a high temperature, is capable of being carbonized. The finely-divided ingredients are thoroughly mixed and made into a stiff paste with the carbonizable liquid, and then forced by heavy hydraulic pressure through circular apertures in plates. The continuous cylindrical rods thus obtained are cut into suitable lengths, carefully dried and then heated to incandescence in ovens while out of contact with air. By this process the carbonizable liquids are reduced to a carbon which thoroughly binds together the various ingredients. Experience has shown that the higher the temperature and the greater the length of time during which the carbons are subjected to the baking process, the greater their hardness and the higher their electrical conductivity. In order to insure freedom from slight porosity, in most cases the carbons are subjected to a re-baking. After removal from the oven, they are soaked in strong syrup, and again placed in the oven and heated to incandescence as before.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING OCTOBER 7, 1884.

306,044 Telephone; Charles E. Allen, Adams, Mass., assignor of one-half to Frank J. Calanan, Utica, N. Y.

306,050 Telephone switch; Samuel H. Bartlett, New York, N. Y.

306,051 Accumulating battery; Nicolas Basset, Paris, France.

306,055 Printing telegraph; Charles G. Burke, Richmond Hill, N. Y.

306,056 Printing telegraph; Charles G. Burke, Richmond Hill, N. Y.

306,057 Underground telegraph line; Henry A. Chase, Lynn, Mass.

306,084 Electric alarm and call-bell system for hotels; Warren T. Kellogg, Cohoes, N. Y.

306,118 Electric arc lamp; Elihu Thomson and E. Wilbur Rice, Lynn, Mass., assignors to the Thomson-Houston Electric Company, of Connecticut.

306,119 Electric arc lamp; Elihu Thomson and E. Wilbur Rice, Lynn, Mass., assignors to Thomson-Houston Electric Company, of Connecticut.

306,128 Electric-lighting gas burner; A. Livingstone Bogart, Jamaica, N. Y.

306,146 Press for moulding glass insulators; Lawrence B. Gray, Boston, Mass.

306,147 Press for moulding glass insulators; Lawrence B. Gray and Joseph Ham, Boston, Mass.

306,179 Electric lock; Hilborne L. Roosevelt, New York, N. Y.

306,187 Relay for printing telegraphs; John E. Smith, New York, N. Y., assignor to the Gold and Stock Telegraph Company, same place.

306,201 Alarm apparatus for automatic fire extinguishers; Chas. C. Worthington, Irvington, N. Y.

306,202 Alarm apparatus for automatic fire extinguishers; Chas. C. Worthington, Irvington, N. Y.

306,225 Means for diminishing the consumption of battery in normally closed circuits; Charles Cummings, Reno, Nev., assignor of seven-twelfths to Andrew Fraser, same place.

306,238 Telephone circuit and apparatus; Ezra T. Gilliland, Boston, Mass., assignor to American ell Telephone Company, same place.

306 239 Telephone circuit; Ezra T. Gilliland, Boston, Mass., assignor to the American Bell Telephone Company, same place.

306,240 Metallic circuit telephone system; Ezra T. Gilliland, Boston, Mass, assignor to American Bell Telephone Company, same place.

306,241 Multiple circuit changer; Ezra T. Gilliland, Boston, Mass., assignors to the American Bell Telephone Company, same place.

306,255 Apparatus for working electric bells, etc., W. F. Horn, Carlisle, Pa.

306,255 Conductor for telephone and telegraph purposes; William Jamieson, New York, N. Y.

306,288 Electric sewing machine; William C. Shaffer and J. Lane Poalk, Philadelphia, Pa.

306,296 Telephone support; Theodore N. Vail, Boston, Mass.

306,297 Printing telegraph; Henry Van Hoevenbergh, Elizabeth, N. J., assignor to the Baltimore and Ohio Telegraph Company, Baltimore, Md.

306,315 Electric Railway; Edward M. Bentley, Brooklyn, N. Y.

306,360 Central-office instrument for telephone lines; James P. Stabler, Sandy Spring, Md.

306,361 Individual call instrument for telephones; James P. Stabler, Sandy Spring, Md.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40.00. Various other Foreign patents may also be obtained.

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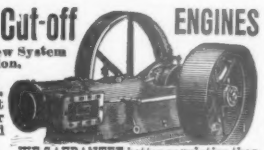

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